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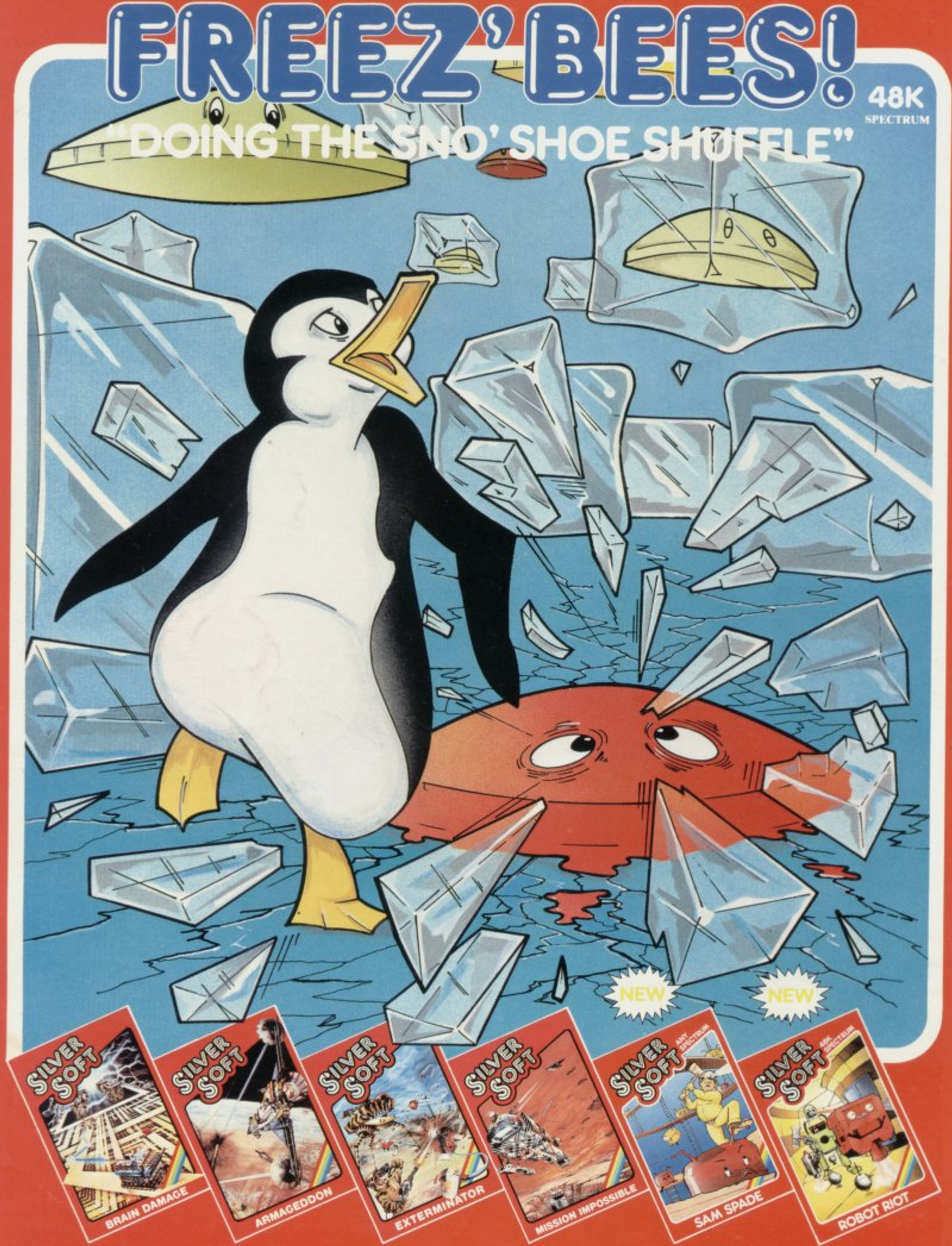
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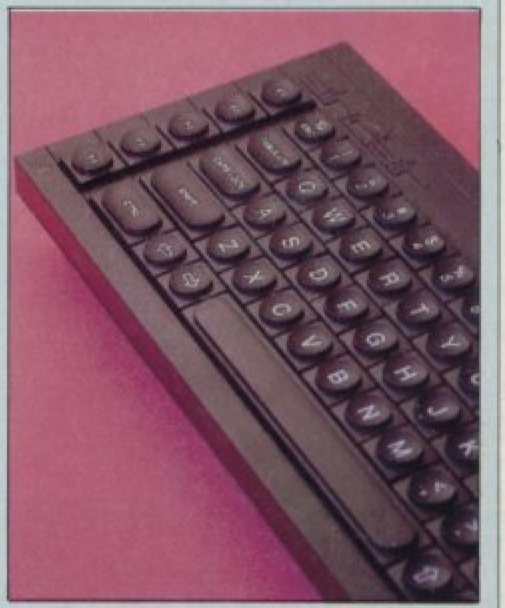
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REGULARS

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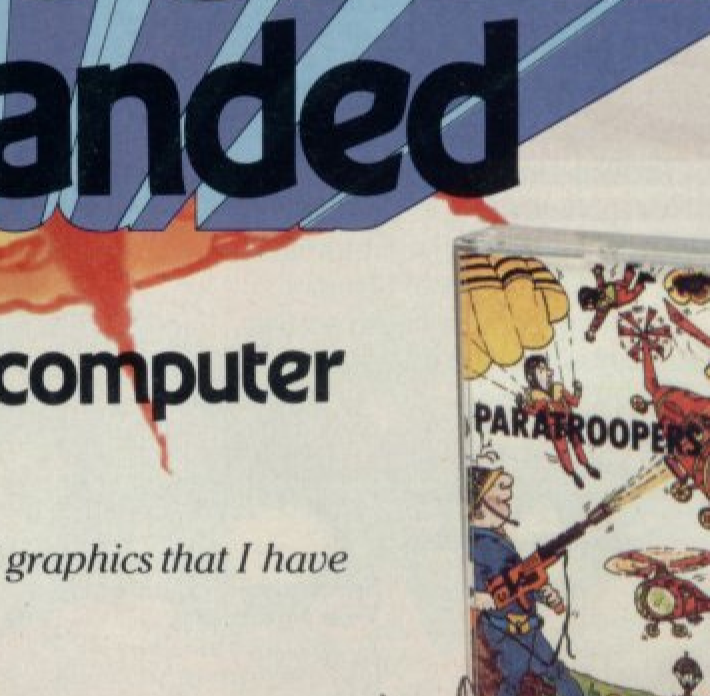
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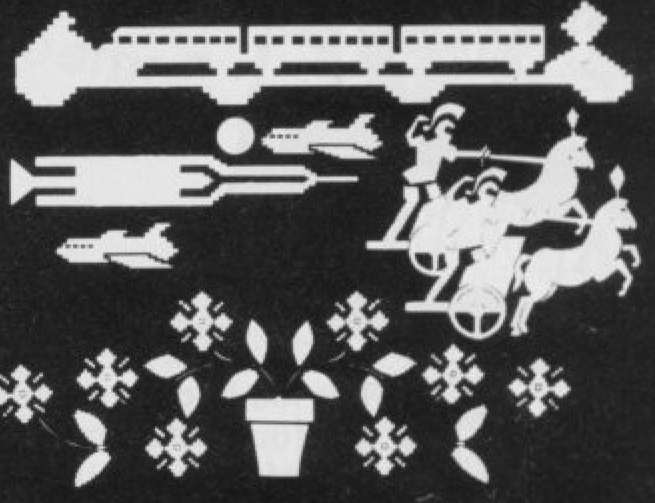
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PROGRAMS 5-8



5 MULTIPLICATION TABLES
6 THE ROMANS
7 SPELLING TESTER
8 HOMOPHONES

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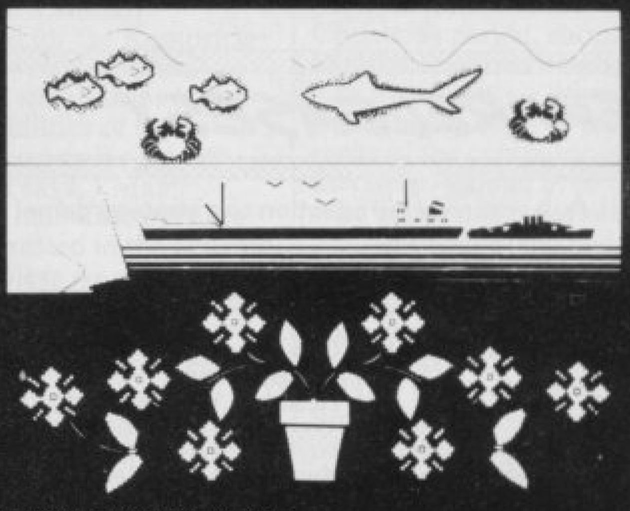
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PROGRAMS 9-12



9 NOUNS, VERBS, ADJECTIVES AND ADVERBS
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11 THE STRUCTURE OF THE FLOWER
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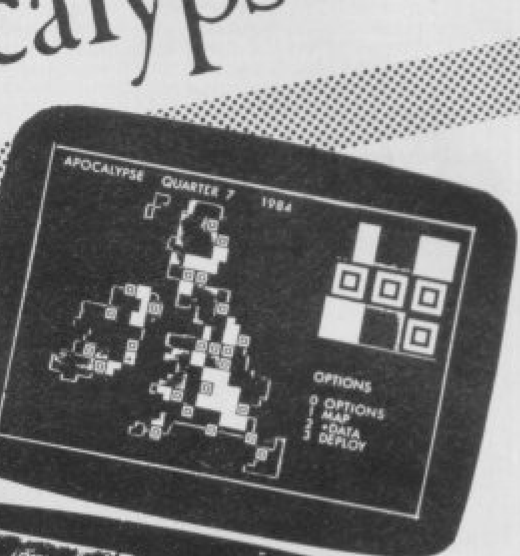
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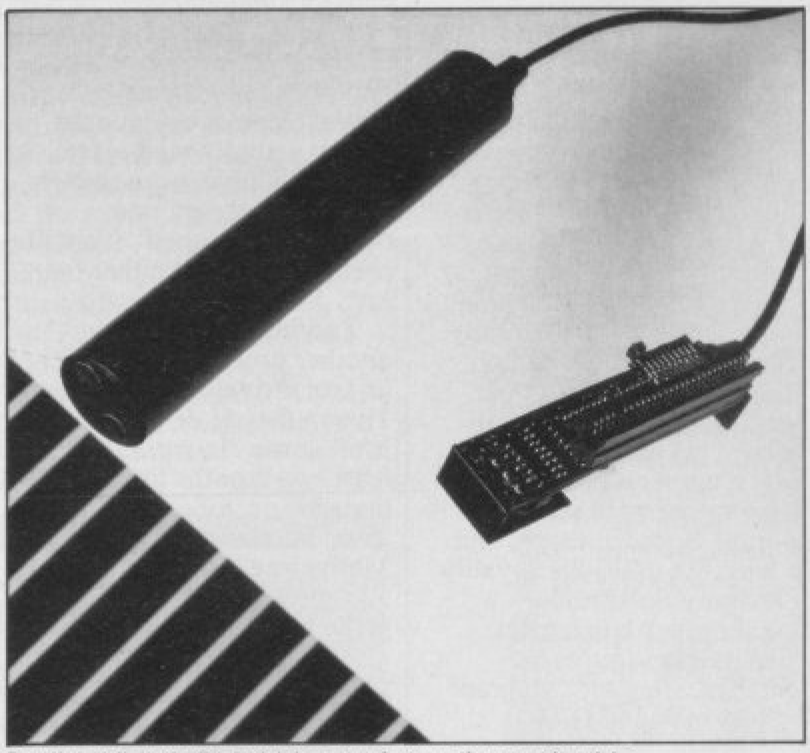
Is it a bird, is it a plane. . . well, it certainly doesn't look like a joystick!

When you first pick up a Trickstick, the idea that it might actually *help* you to play an arcade game seems ridiculous. Built rather like an audio microphone, all you have to do to create movement on the screen is to pass your fingers fleetingly over one of six blue metal buttons (which manage to look like the tops of drawing pins).

Getting down to some practise with Roger Vellacott of East London Robotics (Tricksticks' manufacturers), the device soon lost a lot of its mysterious qualities. The top two buttons move your character from side to side. The next two buttons move you up and down; there are also two fire buttons further down the body of the unit. It's all very easy to explain, but a little tricky to use (maybe that's how it got its name).

The Trickstick works from the mains hum picked up from the tips of the user's fingers, via the metal pads. A signal is fed into the interface you get with the device, and the voltage is converted — in effect — to a digital signal. The circuit contains a capacitor which, when built up via the charge from your fingertips, lets out a pulse that simulates the pressing of a key. A white plastic screw on the main shaft of the Trickstick allows individual adjustment of the device's sensitivity.

So why has a product that was heavily advertised during the latter months of 1983 taken so long to appear on the market? According to Roger Vellacott, the Trickstick was "quite difficult to make. Originally our plans were to use light instead of mains hum, and therefore movement would be related to the amount of light detected by the sensors. It also meant we required a seventh sensor to act as a reference light source, providing a self-adjusting reference point; unfortunately, this just caused problems when someone switched a light on, or the sun came out. Plans to make the Trickstick operate on a light basis were shelved in October 1983, and the current design was begun."



Daunting at first, the Trickstick has more features than most joysticks.

However, the new design involves "much more complex circuitry" — which explains the new price of £34.50. There's also a game that'll be launched alongside the Trickstick to make use of the fact that up to eight of them can be attached to the back of a Spectrum. The game *Attactics,* which involves dogfighting and escaping enemy fighters, allows you to manoeuvre the planes through incredible turns. At £10, the game tape on its own comes rather expensive; but if you buy it with a Trickstick, then you can pick it up for £7.50.

Although you can utilise your Trickstick with any game that's already converted for the Kempston joystick, you won't find anything which takes in the full capabilities of the new device. And as Roger Vellacott says, "Many software manufacturers are very interested in the concept — but unless we sell great quantities of Tricksticks, there won't be many professional eight player games."

For more information on the Trickstick, you'll find East London Robotics at No 11 Gate, Royal Albert Dock, London E16; alternatively, phone 01-474 4430.

RM

KEYNESIAN COURSES

With microcomputers growing ever more prolific in home and office, the Silicon City (Milton Keynes to you!) Information Technology Exchange has decided to have another bash at running some one- and two-day courses. These are pitched primarily at the business user, but course administrator Ann Sidgwick is quick to assure they would also be of benefit "to all potential users". Asked why the idea hadn't lifted-off at the first attempt, Ms Sidgwick said "People are a little slow in Milton Keynes when it comes to computers, and are only just beginning to take an interest. They are still not forward-thinking when it comes to their future understanding of this subject."

In an effort to improve response, the IT Exchange has decided to put out a questionnaire asking people what they would like to see on this year's courses. For further information telephone the IT Exchange on 0908 668866.

RS

SPECTRUM SALES OVERHEAT

Despite the news that Sir Clive managed to notch up his 'millionth Spectrum made' on December 9th, 1983, a few unlucky people may have been cursing the Cambridge wizard over Christmas.

Demand for the ZX Spectrum in the three-month run-up to Xmas was to quote a Sinclair Research spokesperson, "beyond our most optimistic expectations". (Quite an understatement for reported sales of approaching half a million Spectrums.) However, what that meant to Joe Punter on his Clapham Common omnibus was a distinct lack of Spectrums on the shelves. Indeed, it's actually rumoured that, at a late stage, Sinclair Research reduced the number of adverts placed in the press — purely in an attempt to curb catastrophic demand!

Even with production figures topping 100,000 units per month in the pre-Christmas period, shops found themselves having to turn away many a potential micro buyer eager to join the ranks of the computer literates. And not even those wise and wealthy faces at Sinclair Research could foresee that the 48K Spectrum would outsell the 16K model at a reported ratio of eight to one.

High street chain, WH Smith, announced unprecedented sales of home computers over the Christmas holiday and for many of its customers, it was a case of "yes, we have no computers, we have no computers today". But the record, at the time of writing, seems to rest with the Princess Street branch of Menzies where a delivery of 75 48K Spectrums was snapped up by eager Yuletide fanatics in just 15 minutes. Can anyone beat that?

And lastly, the good news for you one or two people *still* not owning a Spectrum — by the time you read this, supplies should have returned to an even keel. **RM**

SINCLAIRWATCH

Atari Spectrumises Its Software.

Atari has recently announced an intention to release its classic arcade games for use with other computers, including the Spectrum. As well as the company's reknown arcade machines, Atari also produces its own high-spec low-cost micros, famed for their grossly expensive software. Atari is, in fact, one of the leading home computer loss makers, with yearly deficits running into hundreds of thousands of dollars, amd are supported by the massive American Warner Corporation.

This latest move is an effort to break into the huge Spectrum software market, and maybe it really is clean-up time as Atari pulls from the hat such classics as *Pacman, Centipede* and *Donkey Kong*, and the rights the company possess to Williams' *Defender*. Ever since the release of the Spectrum, companies have been churning out lookalikes, but few have proved good enough to encourage more than passing customer interest. And those that were well accepted often found themselves swamped by writs alleging copyright infringement, thus calling for cosmetic changes to the title and/or graphics.

Theoretically, with any number of Spectrum users still awaiting an excellent version of *Defender* and *Pacman,* Atari should do well releasing them themselves or becoming the official licensee. However, the company says it is going to charge £14.99, not for the complete set, but for *each* game! Perhaps millionaire Atari 400 owners might consider this cheap, but your average Spectrum user is liable to stand there agog at such a price tag. How long will it take for Atari UK to realise that the British computer market is not about people buying cheap micros and vastly expensive software? It's a policy that's done the company little good in the past and one that's unlikely to fare much better for it in the future — Texas Instruments, please copy.

For Atari's own machines, programmers are apparently offered exceptionally good deals in the form of 35 per cent royalties on the retail price. This pans out to at least a tenner a program — twice the price of your average Spectrum tape, and at least ten times the royality that many Spectrum programmers can expect. Atari is even said to be tempting Spectrum program writers with £10,000 advances.

Topping Up Prices

Talking of inflated prices, there has been recent rumour concerning profiteering in the Spectrum software market — a problem that recently centred around Ultimate's *Atic Atac*. Enquiries for the heavily-promoted mate of *Lunar Jetman* were so great that many dealers opted to stick an extra £1.50 or so on the retail price, an increase of almost 30 per cent. Let's hope that Ultimate steps in and does something before the next blockbusting release.

Another practice that's become painfully obvious these days is the advertising of a new world-beating product, months before anything is ever likely to become available. An award of some kind must go to Sinclair Research, who advertised the Microdrive as 'coming soon' a full 16 months before Sir Clive's tree was to bear fruit. And neighbourly rival, Acorn, comes high in the stakes too with its announcement of the Electron micro at the same time as the Spectrum's appearance — a year before the machine's real launch was to actually take place. And, of course, even though both products are now officially 'launched', it's still pretty hard to get either for love or money.

Turning to software, another produce famous for its late arrival has been *Terror-Daktil 4D*, from Melbourne House. It took at least two months to materialise, following the usual flambouyant Melbourne House launch. No official reason was ever given for the delay, though after about a month a member of Melbourne House's staff was heard to admit that it was still being de-bugged!

And talking of late-comers, whatever happened to the Trickstick from East London Robotics? According to the blurb, it's the ultimate in joysticks, with hitherto unavailable control. Shown in prototype form many months ago and advertised in full colour double pages for almost as long, at the time of writing we are still all waiting to sample the goods.

In many ways, the home computer market is becoming increasingly more commercial and professional. Yet still companies insist on launching product that's just a gap in the managing director's wallet. It's easy to argue that Spectrum enthusiasts are well used to waits of this kind — even so, disappointed customers are unlikely to provide the soundest of bases for most company's long term commercial success.

STACK SHOOTS TO

The Merseyside firm of Stack Computer Services, formed only five years ago by Jeff Orr, has moved away from pure computer retailing, towards the lusher pastures of manufacturing add-ons for other manufacturer's equipment. Its latest, and probably most successful product to date, is the Stack Light Rifle (SLR).

Similar to the old video games where a rifle was attached to the television and the player had to shoot some object on the screen, this device claims a far higher degree of sophistication and is already doing well, judging by the advance orders. Stack

ART FOR ARTS SAKE

If you're looking for a closer involvement with the subtle art of machine code programming, you may be interested to know that you can go and meet Toni Baker and her enthusiastic fellow members of the ZX Machine Code Users' Club on Saturday, March 31. Scheduled to meet in The Amber Room, Sittingbourne Town Hall, Sittingbourne, Kent, the room will be available to all-comers between 10am and four in the afternoon.

It also looks as though one of Toni's longterm projects will be reaching fruition in the near future —the club's magazine, *Micro Arts*. This will be a regular mag, filled with machine code wonders, such as new discoveries, programs, news and info on the club's meetings. Don't send any money yet — just keep watching these pages for news on when it hits the presses.

Fans of Toni's literary works may like to know that she has been wading through *Mastering Machine Code On Your ZX Spectrum* and has come up with an A4 errata sheet which may explain some of those messes you've been getting while typing in the odd program. This can be obtained free from Toni by sending a stamped addressed envelope to 37 Stratford Road, Wolverton, Milton Keynes MK12 5LW.

YS GOES MONTHLY

Thanks to the incredible level support that *Your Spectrum*'s first issue received, we'll be going monthly from our April issue.

Despite the very obvious overcrowding in the computer magazine marketplace, we've proved that there is a very definite need for a 'grown-up' Spectrum magazine. We make no secret of the fact that we deliberately set out to produce a much more demanding user magazine than ever before.

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0 SUCCESS

was strangely tight-lipped about function details, but it seems to work using a single dot of light which scans backwards and forwards down the screen. Thus, when the rifle is aimed and the trigger pulled, the specially written software takes over to record and check co-ordinates. If these match, then the target is removed from the screen and points are awarded accordingly. However, should a mis-match (ie. a 'miss') be recorded, the target remains on-screen and the game will continue as before.

But don't think you've got it all your own way.

Naturally, the SLR can only be used with specially written games and that has led those nice people at Stack to include three cassette-based games with the rifle for an inclusive price of £29.95. And if that's not enough to satisfy you, the promise is there'll be a total of 30 compatible games available by the end of January. You'll get these — and the rifle — either by mail order from Stack Computer Services Ltd, 290-298 Derby Road, Bootle, Merseyside (telephone 051-933 5511) or through WH Smith, Menzies, Boots and others.

RS

SMITHS VERSATILE LOADER



The WH Smith data recorder lets you listen in on saving and loading.

'Own brand' products from large retail outlets tend normally to be cheaper than the better-known variety, but not so in the case of the CPD8300 tape/data recorder from WH Smith.

But at a cost of £39.95, this cassette machine is unlikely to leave its cheaper, non-dedicated competitors free to clean up. That's because it's designed specifically for personal computers, and offers such features as a computer controlled electronic pause, adjustable save and load levels, a meter for indicating same, a tape counter for locating programs easily and a switch that enables one to listen in on program loading (or not as the case may be).

Oh, and it can also be used for boring old audio recording and playback. The device is available from larger branches of WH Smith, ie. those stores which have a home computer section.

RS

SPECTRUM CONTROL

This issue, Roger Pramm turns his attention to music's silver strains — then casts us adrift with savage discord!

The replies and solutions to the problem of the less-than-functioning tactile 'joystick' that appeared in the first issue have been rolling in, and some of them have been rather imaginative. But, not all of them have been complimentary about the code printed to start you off — in fact, one or two of the replies were quite rude (which suggests that some readers simply missed the point). The projects suggested in this column are designed to set *you* thinking and doing exciting things with *your* Spectrum. Interaction is the name of the game.

In the next issue, we'll be taking a brisk look through some of the replies received for our first project — who knows, we might even be able to print a listing that definitively points our wayward 'joystick' in the right direction! But if graphics are not your bag, why not have a go at the project coming right up — you might just turn your Spectrum into a cheap synthesiser.

Project 2

A major problem of using the Spectrum for music is that it's difficult to get it to produce a variable length note based on how long you hold down a key. The standard BEEP instruction requires that you specify the duration of the note beforehand. This makes it impossible to use it for generating notes in the same way that an organ or electronic synthesiser does.

This issue's project is aimed at overcoming that sad handicap and will almost certainly involve delving into machine code. Fortunately, much of the work is already done in the Basic interpreter, and an examination of the keyboard scanning and loudspeaker routines as detailed in *The Complete Spectrum ROM Disassembly* (Ian Logan and Frank O'Hara) will give some clues as to how this might be done.

The problem involves combining the keyboard scanning operation with the sound generation routine. This can be simulated in Basic by setting up a loop which includes a test for what key is being pressed and a BEEP of short duration. This would go something like this:

```
100 REM ** Loop **
200 FOR n= 1 TO 40
300 IF INKEY$ = K(n) THEN
    BEEP 0.00125,N(n)
400 NEXT n
500 GOTO 200
```

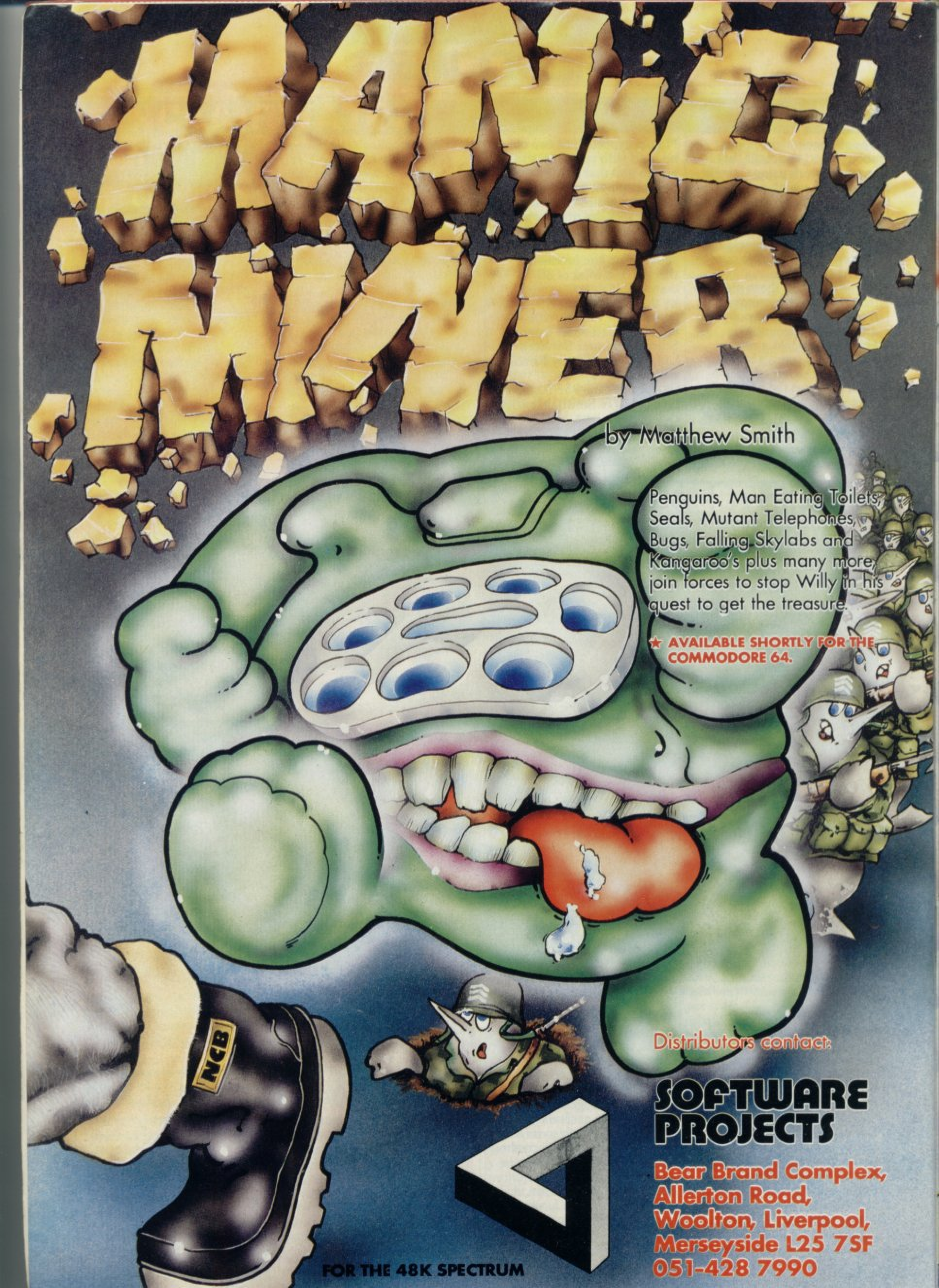
(Note: K is an array with a the keyboard notes READ i from a DATA statement and N is another array wit the frequency numbers store in similar fashion.)

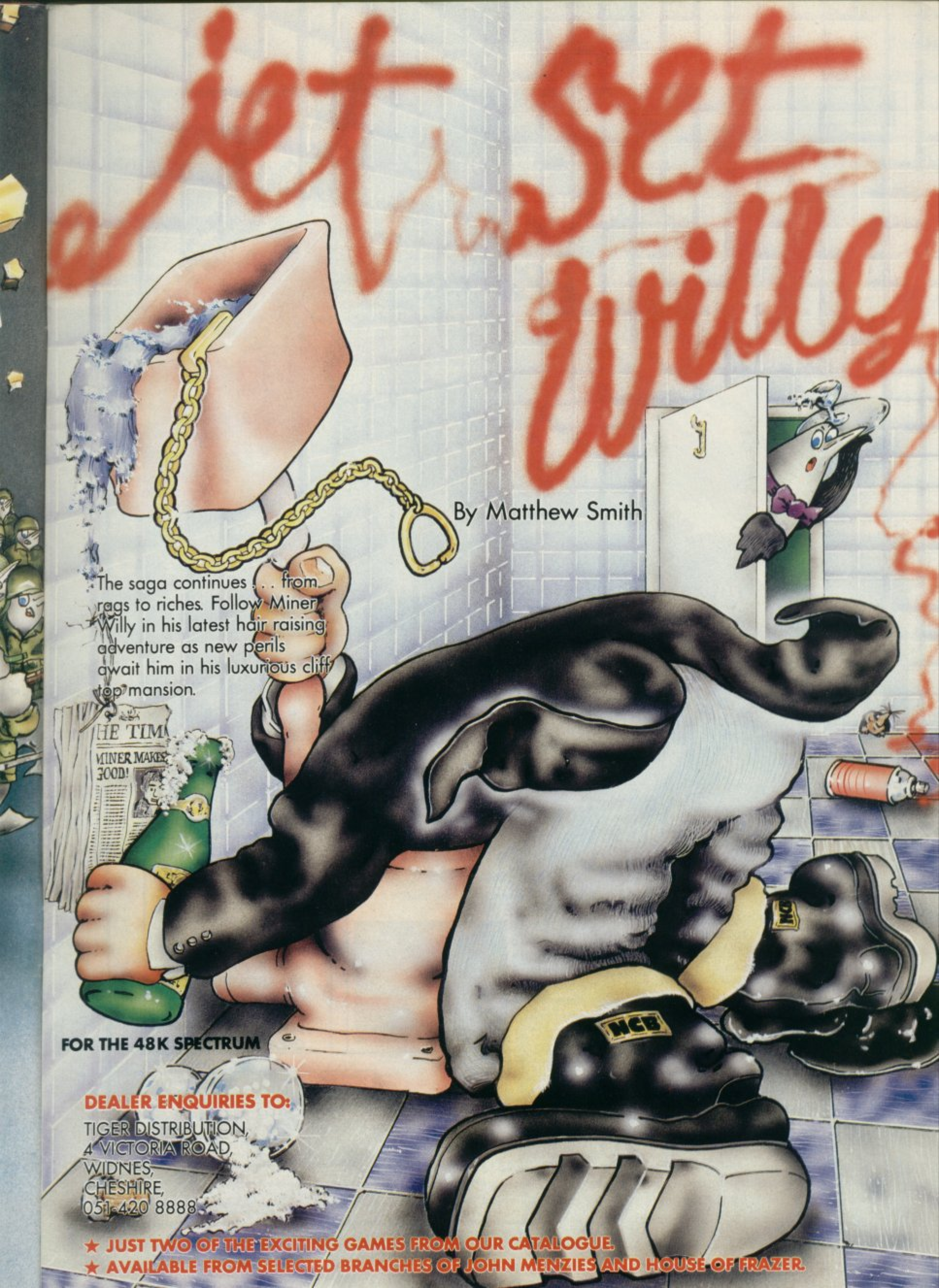
This is a crude representation of how a machine code routine would handle it, and the effect will be to produce a modulated sound which is quite unacceptable. The situation can be improved quite a lot by shortening the arrays to include only those keys that will be used in a simulation of a piano keyboard. If you start with the typewriter key 'F' as F, 'T' as F sharp and so on, you only need about 15 in each array. (The appropriate note frequencies can be found in your Spectrum manual.)

The scan time on the keyboard can also be altered by doing a POKE on the appropriate systems variable to increase the speed of the scan. In the end, though, the speed of the Basic interpreter is the real limiting factor; it's got to be at least 200 times slower than good machine code.

If the keyboard scanning part of the exercise sounds complicated, then the BEEP routine itself is a mind-blower! It works on the principle of setting up a timing loop which will oscillate the tiny loudspeaker a certain number of times a second according to the frequency of the note required. Essentially the BEEP command turns the speaker on and off very quickly and creates a note by varying the speed of the oscillation. This is why the length of the note has to be specified in advance. The oscillation is actually created with an OUT instruction to port 254 with D4 either high (deactivate) or low (activate). By flipping back and forwards between a high and low value, the BEEP routine produces the sound.

This is a toughie, so good luck. Remember, there are no prizes for all your hard work — just tell us how you're getting on by writing to: *Spectrum Control, Your Spectrum, 14 Rathbone Place, London W1P 1DE.*


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The saga continues . . . from rags to riches. Follow Miner Willy in his latest hair raising adventure as new perils await him in his luxurious cliff top mansion.
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NO GROUCHING

So confident is Automata that its adventures are horrendously difficult to solve, the company keeps offering prizes of inestimable value for the first correct solution.

The first of these challenges appeared back in October 1982, and the news is that it's still to be beaten. This evolved around Automata's very popular *Pimania* adventure and, 15 months later, still no one has come within a mile of winning the diamond encrusted golden sundial (valued at £6,000) — not even, alas, some poor chap who planned to travel all the way to Bethlehem on Xmas day!

Asked whether the game was too boring, too complicated or just plain not selling in enough quantity, Automata's spokesperson hedged two-thirds of the question and would only commit herself to saying "It's not at all boring."

But it would be wrong to draw too many conclusions from that and, spirits never dampened (and not content with just one prize puzzle), Automata is now offering a free trip to Hollywood to meet the 'star' who can be identified by solving its laboriously named package *'My name is Uncle Groucho. You win my fat cigar'.* The excited winner will fly out on Concorde, stay at the Waldorf Astoria, sail back on the QE2, and receive £500 pocket money to boot. But hurry, because the competition ends on June 1st, 1984. **RS**





Big prizes await those first solving Automata's adventure games.

DEBUGGIT

```
 10 LETt=0
 20 LET a$=""
 30 PRINT "Do you think a joyst
ick is:"
 40 PRINT
 50 PRINT "a) A device for cont
rolling an      aeroplane"
 60 PRINT "b) Somthing your gir
lfriend         likes"
 70 PRINT "c) An object for ent
ertaining       the dog"
 80 INPUT a: PRINT a
 90 IF a$="a" THEN  LET t=t+1
100 IF a$="b" THEN  LET t=t+2
110 IF a$="c" THEN  LET t=t+3
120 PRINT
130 PRINT
140 PRINT "You would like to li
ve in         America because:"
150 PRINT
160 PRINT "a) You forgot to unp
ack the         machine"
170 PRINT "b) You haven t got a
 TV set or      monitor"
180 PRINT "c) You re watching B
BC 2"
190 INPUT a$: PRINT a$
200 IF a$="x" THEN  LET t=t+2
210 IF a$="y" THEN  LET t=t+3
220 IF a$="z" THEN  LET t=t+4
230 PRINT
240 PRINT
250 PRINT "When your software i
s loading.  do you:"
260 PRINT
270 PRINT "a) Jog round the blo
ck"
280 PRINT "b) Feed the cat"
290 PRINT "c) Have a nervous br
eakdown as       a loading error a
ppears 14"
300 PRINT "    minutes into a 15
 minute         program"
310 INPUT a$: PRINT a$
320 IF a$="a" THEN  LET t=t+1
330 IF a$="b" THEN  LET t=t+3
340 IF a$="c" THEN  LET t=t+4
350 PRINT
360 PRINT
370 PRINT "Which one of the fol
lowing is     impossible"
380 PRINT
390 PRINT "a) Walking on water"
400 PRINT "b) Holding your brea
th for 30       minutes"
410 PRINT "c) Typing on a Spect
rum keyboard"
420 INPUT a$: PRINT a$
430 IF a$="a" THEN  LET t=t+1
440 IF a$="b" THEN  LET t=t+3
450 IF a$="c" THEN  LET t=t+4
460 PRINT
470 PRINT
480 PRINT "You don t get a pict
ure from a  Spectrum because:"
490 PRINT "a) They have thick s
teaks"
500 PRINT "b) Ronald Regan is P
resident"
510 PRINT "c) The US version of
 the             Spectrum has a de
cent             keyboard"
520 INPUT a$: PRINT a$
530 IF a$="a" THEN  LET t=t+2
540 IF a$="b" THEN  LET t=t+3
550 IF a$="c" THEN  LET t=t+4
560 IF t<=9 THEN  GO TO 590
570 IF t>=10 AND t<=15 THEN  GO
 TO 600
580 GO TO 610
590 PRINT "You are a clever lit
tle so-and- so, aren't you?  You
 probably   love talking about y
our          Spectrum, and never
stop going  on about your latest
 peeking andpoking. You probably
 bore peopleto death at parties
by talking  to them in machine c
ode.": STOP
600 PRINT "You're not that both
ered about  playing with your Sp
ectrum.         You probably got it
 as an          unwanted Christmas p
resent when you really wanted a
polka-dot    tie or a new pair of
 carpet      slippers.  Come to t
hink of it, what are you doing r
eading this magazine?": STOP
610 PRINT "You like playing wit
h your        Spectrum, but you pr
obably have time for the trivial
 aspects of life, such as talkin
g to the     kids,eating nd going
 to the       bathroom.": STOP
```

For all those debugists who tried desperately to find the silly mistakes left by *YS* idiot, Dick Head, here are the corrections.

1. Line 10 should read — BORDER 2: PAPER 6 (or some other choices that make it possible to read the screen!).
2. Lines 60 and 290 were transposed.
3. Line 100 should check if r is not equal to one, not 10.
4. Line 170 should check if bc is greater than or equal to 90, and the GO SUB should be to line 380.
5. Line 240 should check for r not being equal to one, not 10.
6. Line 260 should read — PRINT AT 10,0 . . . (and not PRINT AT 0,10).
7. Line 290 was transposed with line 60 (see item 2).
8. Line 380 should check for f (not m).
9. Line 490 should be a RETURN statement (and not the GO TO statement Dick Head managed to come up with).

These were the specific errors made by our Dick — but as with any bugged-up excuse for a program, there's more than one solution. So what we've done is that worked properly, whether or not they uncovered all DH's errors.

The ten lucky winners of the £25 tokens are: **Cameron Naish,** Oxford; **Tony Nall,** Southsea, Hants; **Byron Partridge,** West Ealing, London; **Mr I Grant,** Willenhall, West Midlands; **Tony Giscombe,** Droitwich, Worcs.; **Jolyon Ralph,** Wimbledon, London; **Nicola Elsom,** Saffron Walden, Essex; **Paul Vanlint,** Walthamstow, London; **Mr J Fewings,** Hull, North Humberside; and last but not least, **Mark Gibson** of Wigginton, York.

HE'S DONE IT AGAIN

Will nothing keep a good moron down? Not content with last issue's ludicrous nonsense, DH has now landed us with another load of programming codswallop —this time entitled *Choices*. As usual it's racked with errors, but he assures us that anyone who gets it going will find it 'deeply meaningful' — coming from Dick, that's a contradiction in terms!

Anyway, here it is. For those unable to figure it out, he reckons he'll be listing the corrections next issue — that's a joke!

V RANGE FROM CARNELL SOFTWARE



COMING SOON

"THE WRATH OF MAGRA"

The first born has been destroyed. The Black Crystal of Beroth has been banished. The alliance of Evil has been defeated by the armies of Lord Fendal. So ends the Third Age. Now we invite you to write your name in the history of the Fourth Age of the Third Continent.

You will meet friends and enemies, old and new, in the long awaited sequel to Volcanic Dungeon. Using high resolution graphics and combining the best qualities of "Black Crystal" and "Volcanic Dungeon", we will allow you to become part of this tale of revenge.

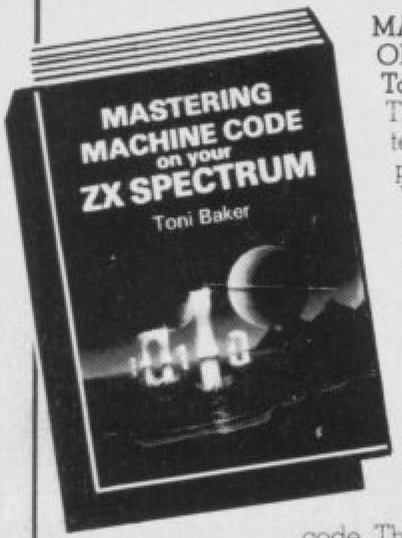
"The Wrath of Magra" comes as three, 48K programmes on cassette, boxed with instruction manual and book detailing the history of the Third Continent and the many spells you will be using throughout the game.

NOTE: "The Wrath of Magra" is a complete adventure. You need not buy "Volcanic Dungeon" or "Black Crystal" to play it.

CARNELL SOFTWARE LTD

At last!

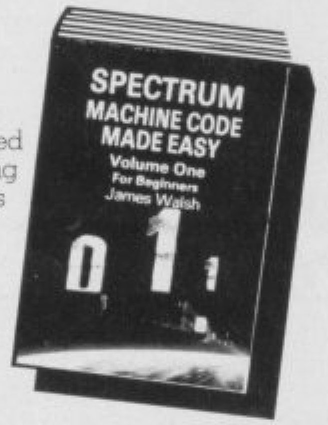
MASTER MACHINE CODE on your Spectrum



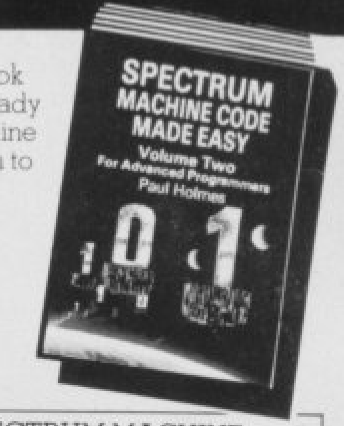
MASTERING MACHINE CODE ON YOUR ZX SPECTRUM
Toni Baker £9.95

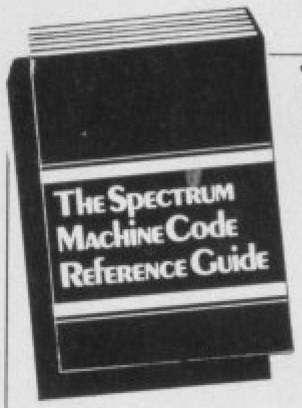
This 315-page book is designed to teach you the essential elements of programming in machine code. Written by Toni Baker, author of the highly successful 'Mastering Machine Code on the ZX81', this new book assumes absolutely no previous knowledge of machine code whatsoever, and yet promises to take you to a level of proficiency beyond your wildest dreams. Starting with simple addition and subtraction you'll be slowly guided through the entire subject of machine code. The book explores and utilises the incredible speed of machine code, giving you real time graphics games like BREAKOUT and leads you up to a full working DRAUGHTS program. Among other useful skills you'll acquire the ability to create music in real time (impossible in BASIC) and to plot in high-resolution graphics faster than you would have believed possible.

SPECTRUM MACHINE CODE MADE EASY
Volume One — James Walsh
Volume Two — Paul Holmes



These two books provide a graduated course in machine code programming on the ZX Spectrum. Book one starts off with the basic concepts of machine code, followed by an explanation of binary maths, hexadecimal and base conversion, leading as quickly and painlessly as possible onto the rules and types of addressing the Spectrum's powerful Z80 microprocessor. Book two is designed for those who already understand the rudiments of machine code programming, and now wish to increase their skills.
Each book is just £5.95





THE SPECTRUM MACHINE CODE REFERENCE GUIDE
Microdrive, Interface 1, and ROM Disassembly
Richard Ross-Langley £4.95

This 170-page reference work for Spectrum machine code programmers contains a full disassembly of the Spectrum ROM, with details of the Microdrive and Interface 1. Features of the disassembler include: Zilog mnemonics are used, eg LD A, (HL) instead of MOV A, M; relative jumps show the signed decimal offset and the result; hex values are default and are printed without suffix; decimal values are preceded by a plus or minus sign; and some restart instructions are followed by data bytes. The absolute addresses of all system variables and several important routines have been named, using where possible the standard names shown in the manual. The chapter headings in the Microdrive/Interface 1 section of the book include the RS232 Interface; Microdrive Channel data; Local Area Network; Network Algorithms; System Variables; and a summary of functions. **This book is a must reference work for serious Spectrum machine code programmers.**

Interface Publications, Dept. S, 44 - 46 Earls Court Road, London W8 6EJ

Please send me the following books. I enclose £________

- ☐ Mastering Machine Code on your ZX Spectrum — Toni Baker — **£9.95**
- ☐ Spectrum Machine Code Made Easy, Volume One for beginners — James Walsh — **£5.95**
- ☐ Spectrum Machine Code Made Easy, Volume Two for advanced programmers — Paul Holmes — **£5.95**
- ☐ The Spectrum Machine Code Reference Guide — Richard Ross-Langley — **£4.95**
- ☐ Creating Adventures on your ZX Spectrum — Peter Shaw and James Mortleman — **£4.95**
- ☐ Putting Your Spectrum to Work (includes 15 major programs, including a word-processor and spread-sheet calculations) — Chris Callender — **£4.95**
- ☐ Creating Arcade Games on the ZX Spectrum — Daniel Haywood — **£3.95**
- ☐ Programming Your ZX Spectrum — Hartnell/Jones — **£6.95**
- ☐ 60 Games and Applications for the ZX Spectrum — David Harwood — **£4.95**
- ☐ Beyond Simple BASIC — Delving Deeper into your ZX Spectrum — Dilwyn Jones — **£7.95**
- ☐ Instant Spectrum Programming (tape and book) — Tim Hartnell — **£4.95**
- ☐ 20 Simple Electronic Projects for the Spectrum — Stephen Adams — **£6.45**
- ☐ Giant Book of Computer Games — Tim Hartnell — **£7.95**

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SMASH SOFTWARE

Before the cassette tape there was the record, and those who've been following recent software trends — as opposed to *Duran Duran* — may have noticed a relationship springing up between the two.

So much so in fact that many of the major music publishing companies launched computer-related products in the summer of '83, in the hope of latching on to what they saw as 'micro mania'. EMI released a single by Chris Seivey complete with a B-side program you could pump into your ZX81, and Island Records countered with an LP by ex-Buzzcock, Pete Shelley, called *XL1*. The success (or otherwise) of these records from the point of view of their including a computer program is, according to the respective companies, rather difficult to assimilate. However, Chris Seivey has announced plans to write the programming material for B-sides of other 'name' recording artists, and Pete Shelley is back in front of a computer monitor as well as a microphone — so the feedback couldn't have been that bad.

Indeed, even rock-regurgitator Shakin' Stevens has included a Spectrum program on his latest album. Written by a rather well-known software house, it's difficult to say whether this was purely for the sake of gimmickry — but it's possible to suspect so.

In the forefront of this combination of music and computer technology remain Mainframe, a band from Hemel Hempstead. Lead by John Molloy and Murray Munro, Mainframe produced a single, complete with a program for the Apple computer, as far back as October 1982. The innovation was soon repeated with the release of a second single — one which included programs for both the ZX81 and Spectrum.

With the band's pioneering experience in the area dating all the way back to 1981, Mainframe seems by far the most experienced at using this hybrid concept. But reports from the major music companies is mixed, and it certainly would appear that there were a few problems — not least due to the fact that the recording work was undertaken by music producers rather than computer technicians. As a result, many record buyers and computer users found themselves out of luck in their attempts to feed the dubbed programs to their computers in a form which would load.

However, things move fast in the music industry and the idea of linking music and computing is far from shelved. Indeed, it's said that EMI is looking to create a broad umbrella for ideas which will interrelate with all the new technologies — music, home computing and videos!

Other music biz names are also in the running to achieve the perfect match of music and computing — especially Virgin and Island Records. Virgin already runs a software house and, with its large distribution chain and wide variety of recording artists, would be in a good position to exploit the idea in 1984. Island Records too has not been idle in its attempts to break into the software market and hungry punters may soon be rewarded with the release of a new range of titles from a company being set up in April, called Island Logic. As well as Pete Shelley, the signs are that many other Island recording artists have been bewitched by the evil eye of the micro monitor, including well-known reggae band, Aswad.

Gimmick or not, with the increasing interest of the major music companies in commerical software and the pioneering work of Mainframe, who knows — 1984 could be the year of the musical software package.

Find out more on Mainframe by writing to MC² Music, 24 Missden Drive, Hemel Hempstead, Herts.
RM



fantasy SOFTWARE

The battle could be yours.....
.....but it won't be easy!



This is 'ZIGGY', shown above, in his exploratory capsule and is a true representation of the on-screen graphics.

THE PYRAMID

THE PYRAMID is an arcade style game which has a very adventurous feel to it.

The Pyramid contains 120 chambers on 15 levels. In order to get from one chamber to another you must fight off the indigenous aliens to collect an energised crystal which will neutralize the force field guarding the two exits.

The Pyramid is inhabited by a total of 60 weird and exotic alien types, all of which are beautifully animated. You will meet a whole variety of demons, droids, insects and monsters, with a sprinkling of the more unusual, the extra-terrestrial tweezers, galactic strawberry, cosmic claw, mutant eye, plus a whole host of entities that defy rational description. You'll no doubt invent your own nicknames.

You proceed to explore the pyramid from top to bottom with the difficulty generally increasing with the depth of level. Depending on the choice of exit from each chamber you are likely to have a different game every time you play.

Apart from the challenge of trying to achieve the highest score possible the pyramid contains a number puzzle to solve. The more chambers you successfully visit the more information is gathered to enable you to discover the secret numbers of the pyramid. The puzzle won't take you days to solve, it will probably take you a few months.

DOOMSDAY CASTLE

DOOMSDAY CASTLE consists of a labyrinth of 74 complexly inter-connected Halls and Passages where you will meet a whole host of adversaries serving the infinitely evil Scarthax, the Garthrogs, the Orphacs, the phenomenally nasty Googly Bird and the Urks which manifest themselves in over fifty unbelievably weird and wonderful guises.

Scarthax has scoured the Universe to bring together the six ancient stones of lifeforce. United in Doomsday Castle they are being used to wield an irresistable power over the cosmos, emanating waves of corruption through every galaxy.

To save the Universe, you must battle your way through the Castle to find and collect the six stones and use their force against Scarthax to destroy Doomsday Castle, hopefully escaping yourself before the final cataclysmic explosion.

The task is not easy (saving the Universe never is!) and it will take you many games to unfold the structure of Doomsday Castle and discover the locations of the ancient stones.

The addictive arcade style action will keep you coming back to play but the overall challenge should still keep you occupied for months.

FANTASY SOFTWARE is available from W.H.SMITHS, JOHN MENZIES, BOOTS, LASKYS, GREENS, RUMBELOWS, SPECTRUM GROUP, COMPUTERS FOR ALL and all other good software retailers.

The Pyramid at £5.50 and Doomsday Castle at £6.50 from

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FORUM

Air your views on the Spectrum scene. All correspondence should be addressed to Forum, Your Spectrum, 14 Rathbone Place, London W1P 1DE. Let's hear from you . . .

NO JOY!

The article, *Sticking with adjustables*, in your first issue included a review on the Stonechip Programmable Joystick Interface. Unfortunately, looking at the photograph which accompanied the article, I suspect that you reviewed one of the old interfaces.

When the Programmable Joystick Interfaces were first produced, approximately 100 of them contained an error which caused the border to flash, the keyboard to be disabled, etc. These were delivered before the unit's official launch in September. Most of these defective units have now been returned and replaced with the new device.

From September of last year, all the interfaces leaving our factory no longer have these problems, and may I add are selling well.

PJ Mills, Design Engineer, Stonechip Electronics, Aldershot.

RADIO ON

I should like to congratulate you on your first issue — I hope you continue with your rather more intelligent approach to the machine than appears to be the general rule.

I would like to take this opportunity to draw your readers' attention to a user group I run called SARUG (Sinclair Amateur Radio User Group). It is a user group in the true sense of the word — not a captive market for someone's products as I fear is becoming more usual these days. Being a non-profit organisation, we can't afford to answer enquiries with an enclosed sae but if any of your readers would like more information on our group, then please write to me at the address given below.

Finally, I hope you will continue to produce objective ('real') assessments of the products available on the market. Having been in the software business for 15 years, I am only too well aware of the vast sea of shoddy rubbish around today.

P Newman (G4INP), 3 Red House Lane, Leiston, Suffolk IP16 4JZ.

THE BATTLE CONTINUES . . .

I feel I must write to thank you for being the first publication to acknowledge our existence in your Frontlines article, *Battle of the tapes*. I hope you will allow me to respond to a few points.

Our first competition was indeed challenging, but you failed to point out that we did provide the machine code routine to do the animation. The response proves that our readership didn't find it that difficult to use.

I do think remarks about 'slavish emulation' should be made with great care, especially by the nth Sinclair specific publication of the year. We each attempt to do different things in different medias, and if we can both do it well then we will provide a useful service.

Also, should any readers of our tape magazine have any problems with loading, please can they get in touch with us — we would be more than happy to deal with their enquiries.

Lastly, I am no longer anonymous — hello!

The best of luck to you in the 'Battle of the rags' in 1984.

Roger Swift, 16/48 Editor, London W4.

Sorry to nit-pick, Rog, but actually YS is the first Spectrum specific publication (paper variety) in Britain — not the nth Sinclair specific. Good luck to you too. Ed.

WRITE AWAY!

I found your article on programmable joystick interfaces of considerable interest in your first issue.

However, you neglected to print an address or phone number to which I could direct further enquiries in my quest for an interface from Downsway Electronics. Would it be possible for you to provide this information . . .it's not a secret, is it?

JS Heslop, Berks.

Thank you for our 138th enquiry as to Downsway's whereabouts. There's a sneaking rumour that Downsway are not all that keen for their phone number to be public knowledge at this moment — for more information on this and their joystick interface, you'll have to speak to them on Epsom 27222. Ed.

WHOOPS!

In your first issue as part of the *Spectrum soft* feature, you included a number of excellent screen photographs of the games reviewed. However, I'm not sure you managed to get them in the right order.

I am particularly interested in two of these programs: *Chequered Flag* and *Race Fun*. I have a feeling that the captions for these two photographs may have been switched. Perhaps you could let me know before I part with my hard-earned cash.

L Wilkes, Worcs.

Actually I'm quite sure we didn't get them in the right order — your surmise was correct. For accuracy, you can swap the two captions you mentioned as well as those for Velnor's Lair *and* 3D Strategy. *Any offers for a beaten-up old magazine designer? Ed.*

CLUB CORNERED

The Spectrum users of the Midhurst Group would like to congratulate you on your first issue.

And with the grovelling done, perhaps we can tell your readers a little of what our club gets up to. We meet on the second and last Thursday of each month, and incorporate two computing groups, one of which caters exclusively for the 10 to 14 year old age group.

The aim of the club is to explore all aspects of microcomputer use. And we would like to invite anyone interested in computing, be they students, dedicated users, professionals or whatever, to contact us for further information. Enquiries should either be addressed to Val Weston, 69 Petersfield Road, Midhurst, West Sussex, or contact myself at the address below.

RMC Armes, One Knockhundred Row, Midhurst, West Sussex GU29 9DQ.

ACID COMMENTS

I have just got through B.A.S.I.C. on my 48K Spectrum with a few unknown variables and a syntax error in my space invaders.

What next? Perhaps machine code, but base 16 does seem a bit steep — maybe I've got a thing about six-sided shapes. What about Fourth or Fifth as a language, or perhaps Pascal — or could I go into electronics or robotics? Maybe I should train my Spectrum to do tricks, but how do I blow up its nose (maybe its ROM port?).

Which of these would you recommend for a computer expert of tomorrow . . . or even next Wednesday?

RA Watson, The North.

PS If all else fails where could I get a good trade-in on a cabbage patch doll.

Well, er, what can I add . . . Ed.

IT'S AN EDUCATION

Congratulations on the **appearance of the first issue of *Your Spectrum* — the staff** (and the children!) of our school, Finham Junior Mixed School, found the content very interesting.

Will your magazine bed interested in the Spectrum's involvement with education? We are one of the few primary schools in England (a mere 4 per cent) that opted for the Spectrum as our school computer under the DoI scheme, and we have to work a little harder trying to find good educational software.

Many software publishers produce exclusively for the BBC Micro (80 per cent of primary schools) or the RML 480Z (16 per cent of primary schools) — and yet we still think we have chosen the right computer for the job! We have four Spectrums in the Junior Computer Department and two in the Infants Computer Department. Both the children and many of their parents are extremely enthusiastic.

We also have visitors from

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other schools to see our work on computers, but we never lend software — we feel that the protection of copyright is in everyone's interest in the long run.

Incidently, the school chess club did their own survey of Spectrum chess programs and Psion's *Cyrus Is Chess* was an easy winner.
PD Fiddler, Coventry.

Plans are already afoot for YS's involvement on the education front. Ed.

BREAKING-IN TO 16K

In the articles, *Machine code breakout*, Toni Baker said that she knew of no way of implementing the program on a 16K Spectrum. Therefore, the following solution may be of interest.

It's first of all necessary to realise that the 'default' value for unused ports on the Spectrum is FF. And if a mode 2 interrupt occurs with no peripheral attached then the interrupt will vector to the address formed by the contents of xxFF, where 'xx' is the content of the I register.

Now, this xxFF address could be anywhere in either ROM or RAM. But, the contents of xxFF together with the following location must form a RAM address less than 4000 Hex.

A search of the ROM does, in fact, produce several addresses which meet the requirements — the best of these being 28FF. Others, although suitable, produce lower RAM addresses and are more likely to be inconvenient.

If the I register is loaded with 28 Hex, a mode 2 interrupt will vector to 7E5C. The program would, thus, start there:

```
ORG 7E5C
PUSH AF
etc.
```

The ACTIVATE and DEACTIVATE routines can be placed anywhere suitable in memory and called from either Basic or machine code. Incidently, it's advisable to disable interrupts whilst changing the contents of the interrupt register. The ACTIVATE routine would thus become:

```
DI
LD A,50    Load 1 with 28 Hex
LD I,A
IM 2
EI
RET
```

PS Oliver, Cheshire.

16K RESET CONTINUED . . .

After a fair amount of finger-tapping on my 16K Spectrum, I have managed to persuade the small machine to simulate the routine written by Toni Baker in your first issue.

I have located the code within the printer buffer using the automatic vectoring of the Z-80 in interrupt mode 2. The I register is then loaded with 37 Hex which, when added to the hardware vector, 255, gives the following:

$$256 * 37 + 255 = 9727$$

This address in ROM gives a 16-bit address of 118,92, and will produce an automatic jump to address 23670 (256 * 92 + 118). Address 23670 is the home of the system variable 'seed', KSEP, when the RANDOMIZE statement is called.

I have placed a relative jump (two bytes) where 'seed' was located so as to enter the printer buffer three bytes from the end. These last three bytes can then be used as a direct jump to anywhere in memory (address 23350 is used in the program).

Here are a few important things to remember when using this program:

1. *Do not use the command 'RANDOMIZE' in your programs, or to call the 'reset' program. Use instead LET A NAME =* USR nnnnn.
2. *Do not connect any peripheral hardware when using the 'Reset' program.*
3. *Activate the 'Reset' program using the command LET ACT =* USR 23296.
4. *Deactivate the 'Reset' program using the command LET DEACT* = USR 23328.
5. *Should you want to save the program to tape, use the command SAVE "RESET" CODE 23296, 112.*

Load the fully disassembled listing of my 112 byte 'Reset' program into your 16K Spectrum, and your machine code problems should be over . . . or do I mean, just beginning?

Your readers might also be interested to know I have found the solution to one or two errors that have cropped up in David Webb's *Super charge yourSpectrum*, a book published by Melbourne House. In chapter 29 of the text, there are two programs which imitate a TRACE function for the 16K and 48K Spectrum. Unfortunately, both routines have been assembled from location 00000, which causes a system crash when run. Each time PRNTNUM is called in the 16K TRACE routine, the listing calls for you to type in CD 4D 00 — this is wrong, and you should instead type CD 49 7E. Similarly, in the 48K TRACE routine, you should type CD 41 FF instead of CD 5F 00.□
A Dearden, Cleveland.

Machine Code		Assembler	Comments
		ORG 25296	
SE18		LD A,24	Load the 'seed' system variable with JR back to 23549
32765C		LD (23670),A	
SE85		LD A,133	
32775C		LD (23671),A	
3EC3		LD A,195	
32FD5B		LD (23549),A	Load the last three bytes of the printer buffer with a direct jump to 23350 (5B36 Hex).
3E36		LD A36H	
32FE5B		LD (23550),A	
3E5B		LD A,5BH	
32FF5B		LD (23551),A	
3E25		LD A,37	Activate
ED47		LD I,A	Load the I register with 37
ED5E		IM 2	Interrupt mode 2
C9		RET	
3E3F		LD A,3FH	Deactivate
ED47		LD I,A	
ED56		IM 1	
C9	RESMES	RET	
52455345		DEFM 'RESET executed!'	A message. Note that the last byte is inverted, ie. 80 Hex is added
54206578			
65637574			
6564A1			
F5		PUSH AF	
3EFE		LD A,0FEH	
DBFE		IN A, (0FEH)	
1F		RRA	Test caps shift
3807		JR C,NORES	
3EBF		LD A,0BFH	
DBFE		IN A, (0FEH)	
1F		RRA	Test Enter
3004		JR NC,RESET	
F1	NORES	POP AF	
FF		RST 38H	
ED4D		RETI	Return fro interrupt if no reset
2AB25C	RESET	LD HL,(23730)	
2B		DEC HL	
F9		LD SP,HL	
2B		DEC HL	
2B		DEC HL	
223D5C		LD (5C3DH),HL	Return ERR_SP
AF		XOR A	
32715C		LD (5C71H),A	
CD0116		CALL 1601H	
CB6E0D		CALL 0D6EH	
213B5C		LD HL,5C3BH	
CB9E		RES 3,(HL)	
23		INC HL	
CBEE		SET 5,(HL)	
AF		XOR A	A register to zero — entry number of message in table
11265B		LD DE,RESMES	DE register pair set to base address of table
CD0A0C		CALL 0C0AH	
FB		EI	
C3A912		JP 12A9H	Jump to main execution loop

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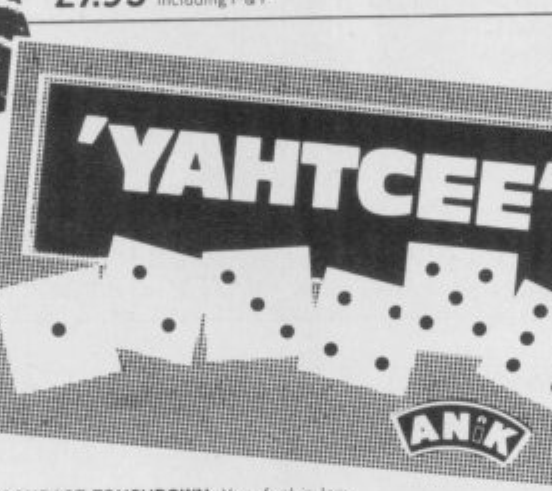
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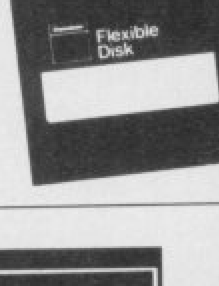


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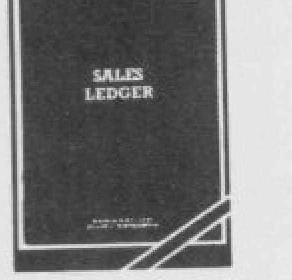
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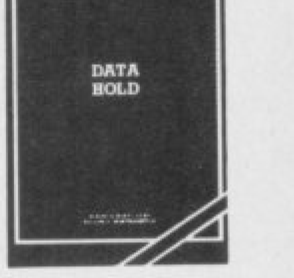
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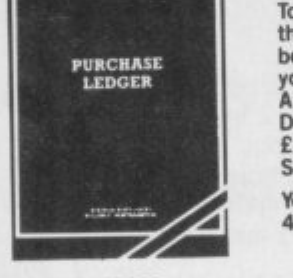
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TAKE A RUNNING JUMP

If you've marvelled at the manic figures zipping around your video screen — then wonder no longer at how it's done. Improve your own arcade games by leaps and bounds with this zappy little routine from machine code maestro, Toni Baker.

The object of this issue's exercise is to present a machine code routine which may be used in Basic programs for a wide variety of totally pointless — but fun — games. With it in operation you see a little figure on the screen, that at the touch of the left or right cursor keys, will happily run along the screen in a horizontal straight line. A touch of the up cursor key and the mischevious character will jump into the air and land back down again! Don't ask me what for — you're the programmer!

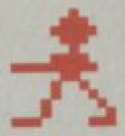
A few simple PEEKs are all that are needed to tell the program where the figure is, and a couple of POKEs will

Moving Graphics Data

```
FIGURES
DEFB 00 01 03 03 01 00 01 3F    Data for the left facing figure (1).
DEFB 00 80 C0 C0 80 80 C0 E0
DEFB 01 02 02 04 04 38 00 00
DEFB 80 40 20 10 08 38 00 00
```



```
DEFB 00 01 03 03 01 00 01 3F    Data for the left facing figure (2).
DEFB 00 80 C0 C0 80 80 C0 E0
DEFB 01 01 02 04 0F 00 03 00
DEFB 80 80 80 80 F0 90 90 00
```



```
DEFB 00 01 13 0B 05 02 01 01    Data for the left facing figure
DEFB 00 80 C0 C0 80 80 C0 A0    jumping.
DEFB 01 01 02 04 02 01 03 00
DEFB C0 80 40 40 40 40 C0 00
```

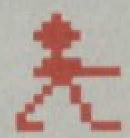


```
DEFB 00 00 00 00 00 00 00 00    Data for the blank space.
DEFB 00 00 00 00 00 00 00 00
DEFB 00 00 00 00 00 00 00 00
DEFB 00 00 00 00 00 00 00 00
```

```
DEFB 00 01 03 03 01 01 03 07    Data for the right facing figure (1).
DEFB 00 80 C0 C0 80 00 80 FC
DEFB 01 02 04 08 10 1C 00 00
DEFB 80 40 40 20 20 1C 00 00
```



```
DEFB 00 01 03 03 01 01 03 07    Data for the right facing figure (2).
DEFB 00 80 C0 C0 80 00 80 FC
DEFB 01 01 01 01 0F 09 09 00
DEFB 80 80 40 20 F0 00 C0 00
```



```
DEFB 00 01 03 03 01 01 03 05    Data for the right facing figure
DEFB 00 80 C8 D0 A0 40 80 80    jumping.
DEFB 03 01 02 02 02 02 03 00
DEFB 80 80 40 20 40 80 C0 00
```



This data should be entered at the end of the main machine code listing. You should then replace the question makrs at the LD BC, FIGURES routine to point to the beginning of the moving graphics data.

Machine Code		Assembler	Comments
FD5676	START	LD D,(A_FLAGS)	
CBA2		RES 4,D	Signal 'No move made yet'.
CB4A		BIT 1,D	Is the figure jumping?
2033		JR NZ,UP/DOWN	Go straight to the 'up/down' routine if so.
3EF7		LD A,F7	Note: bit three reset.
DBFE		IN A,(FE)	Scan segment three of the keyboard.
E610		AND 10	A:= 00 if key '5' pressed, 10 otherwise.
47		LD B,A	B:= 00 if key '5' pressed, 10 otherwise.
3EEF		LD A,EF	Note: bit four reset.
DBFE		IN A,(FE)	Scan segment four of the keyboard
E604		AND 04	A:= 00 if key '8' pressed, 04 otherwise.
B0		OR B	A:= 00 if both key '5' and '8' pressed; 04 if key '5' pressed, but not key '8'; 10 if key '8' pressed, but not key '5'; 14 if neither key pressed.
FE04		CP 04	Test for key '5' only.
2814		JR Z,LEFT	Move figure left if so.
FE10		CP 10	Test for key '8' only.
201D		JR NZ,UP/DOWN	Go straight to 'up/down' routine unless pressed.
CBD2	RIGHT	SET 2,D	Signal 'figure facing right'
3AAF5C		LD A,(POS_X)	A:= current x co-ordinate.
FE1E		CP 1E	Are we at the right of the screen?
2814		JR Z,UP/DOWN	Exit if so.
FD3475		INC (POS_X)	Otherwise change x co-ordinate.
CBE2		SET 4,D	Signal 'figure has moved'.
180D		JR UP/DOWN	Go to the JUMP key test.

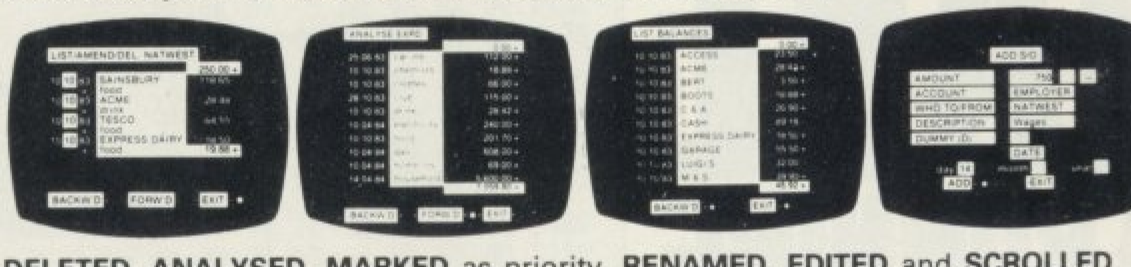
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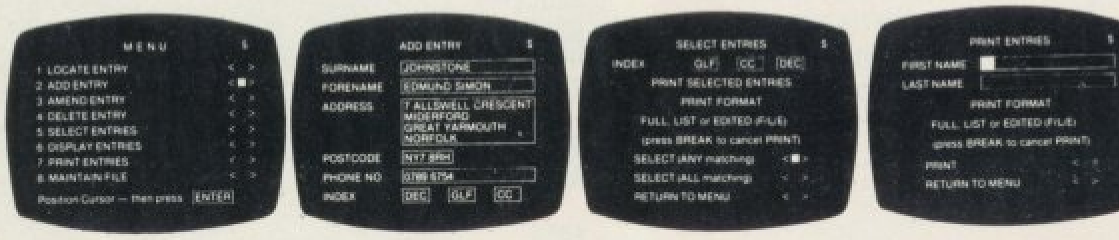


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Machine Code		Assembler	Comments
CB92	LEFT	RES 2,D	Signal 'figure facing left'.
3AAF5C		LD A,(POS_X)	A:= x co-ordinate of the figure.
A7		AND A	Is it at the left of the screen?
2805		JR Z,UP/DOWN	Exit if so.
FD3575		DEC (POS_X)	Otherwise change x co-ordinate.
CBE2		SET 4,D	Signal 'figure has moved'.
3EEF	UP/DOWN	LD A,EF	Note: bit four reset.
DBFE		IN A,(FE)	Scan segment four of the keyboard.
E608		AND 08	A:= 00 if key '7' pressed, 08 otherwise.
2804		JR Z,J_PRESSED	Jump if the JUMP key pressed.
CBAA		RES 5,D	Signal 'JUMP key not pressed'.
180A		JR JUMP_TEST	
CB6A	J_PRESSED	BIT 5,D	Was the key already pressed?
CBEA		SET 5,D	Signal 'JUMP key pressed'.
2004		JR NZ,JUMP_TEST	Exit unless the key is pressed for the first time.
CBCA		SET 1,D	Signal 'figure is jumping'.
CBB2		RES 6,D	Signal 'figure moving upwards'.
CB4A	JUMP_TEST	BIT 1,D	Is the figure jumping?
281C		JR Z,PRINTOUT	Exit if not.
CBE2		SET 4,D	Signal 'figure has moved'.
CB72		BIT 6,D	Is the figure moving up or down?
2809		JR Z,UP	
FD3577	DOWN	DEC (JUMP_HEIGHT)	Decrease the height above the ground.
2011		JR NZ,PRINTOUT	Jump unless the figure has reached the ground.
CB8A		RES 1,D	Signal 'figure no longer jumping'.
180D		JR PRINTOUT	
3AB15C	UP	LD A,(JUMP_HEIGHT)	A:= height above the ground.
3C		INC A	A:= new height.
32B15C		LD (JUMP_HEIGHT),A	Store the new height.
FE04		CP 04	Are we at the top of a jump?
2002		JR NZ,PRINTOUT	Exit if not.
CBF2		SET 6,D	Signal 'figure now moving downwards'.
FD360200	PRINTOUT	LD (TVFLAG),00	Direct PRINT to upper part of screen.
7A		LD A,D	A: contains all the flags.
CB4A		BIT 1,D	Is the figure jumping?
2804		JR Z,XXX	
E6FE		AND FE	If so then reset the animation flag.
1802		JR YYY	
EE01	XXX	XOR 01	Otherwise complement the animation flag.
32B05C	YYY	LD (A_FLAGS),A	Store amended flags.
CB62		BIT 4,D	Has the figure moved?
C8		RET Z	Return if not.
ED5BAC5C		LD DE,(LAST_POS)	DE:= previous co-ordinates of the figure.
3E03		LD A,03	A:= code for a blank space.
CD????		CALL FIGURE	Print a blank space, overwriting the previous figure.
ED5BAE5C		LD DE,(POS)	DE:= present position (with the figure assumed to be on the ground).
7B		LD A,E	A:= y co-ordinate of the ground.
FD9677		SUB (JUMPHEIGHT)	A:= true y co-ordinate of the figure.
5F		LD E,A	DE:= true current co-ordinates.
ED53AC5C		LD (LAST_POS),DE	Store these co-ordinates.
3AB05C		LD A,(A_FLAGS)	A: contains all the flags.
E607		AND 07	A:= code for the appropriate figure to print.

move our friend to any part of the screen. Therefore, the Basic is totally interactive with the machine code. It is quite feasible to make some kind of video game out of this routine ising no other machine code at all — so, if you feel that particular area is beyond you at present, there's still plenty for you to do in the meantime.

WHAT'S THE POINT

If you don't understand machine code then a couple of points are worthy of explanation. The left-hand column of the machine code listing is all you need to feed into the computer. The other columns are just there to give additional information. However, you'll notice there are a couple of question marks in the left-hand column of the listing which are not part of the machine code; they are a warning that these are addresses which you'll need to work out for yourself. For instance, where it says CD???? in the left-hand column, and CALL FIGURE in the middle column, it means that the question marks in the left-hand column should be replaced by the *address* of the line of machine code which has the label FIGURE written in the second column. This address must be in hexadecimal, and with the two component bytes in reverse order — so, for instance, if the line labelled FIGURE ends up at address 24962 then the question marks in the line CALL FIGURE will need to be replaced by 8261, since 24962 (decimal) equals 6182 (Hex). If

10 POKE 23724,16	y co-ordinate of the figure.
20 POKE 23725,0	x co-ordinate of the figure.
30 POKE 23726,16	As line 10.
40 POKE 23727,0	As line 20.
50 POKE 23728,0	Reset all flags in A_FLAGS.
60 POKE 23729,0	Reset the height above the ground.
70 RANDOMIZE USR ?????	This refers to the label START in the program.
80 GO TO 70	

Figure 1. The bare essentials of a game, so that you can see the potential of the code in action.

you start the program as a whole at address 6000 (Hex) then this will actually be the case.

The routine makes use of a couple of addresses in the system variables, which you can PEEK and POKE in Basic in order to make the game do whatever you want. These are:

23726 The y co-ordinate of the horizontal line along which the figure runs.
23727 The x co-ordinate of the figure.
23729 The height of the figure above the ground.

In addition, there are three more addresses *which you should not use* in the course of a game, but which none-



Machine Code		Assembler	Comments
6F	FIGURE	LD L,A	
2600		LD H,00	HL:= code for the figure to print.
29		ADD HL,HL	
29		ADD HL,HL	
29		ADD HL,HL	
29		ADD HL,HL	
29		ADD HL,HL	Multiply by 20h.
01????		LD BC,FIGURES	BC:= points to the data for the figures.
09		ADD HL,BC	HL: points to the data for a specified figure.
010800		LD BC,0008	BC:= number of bytes per character square.
CD????		CALL HALF_FIGURE	Print the top half of the figure.
1C		INC E	Change y co-ordinate in order to print the bottom half of the figure.
3E16	HALF_FIGURE	LD A,"at control"	
D7		RST 10	PRINT AT
7B		LD A,E	
D7		RST 10	E,
7A		LD A,D	
D7		RST 10	D.
CD????		CALL FIG_SQ	Print one character square of the figure. (Now to print the second character square. . .)
227B5C	FIG_SQ	LD (UDG),HL	USR "A": points to the data to print.
3E90		LD A,"Graphic A"	
D7		RST 10	Print one character of the figure.
09		ADD HL,BC	Point HL to the data for the next square.
C9		RET	End of the routine.

theless must be POKEd with certain initial values before the game starts. These are:

23724 As 23726 initially.
23725 As 23727 initially.
23728 Must be POKEd with zero initially.
(Note also that 23729 must also be POKEd with zero initially).

Figure 1 shows the bare essentials of such a game. Lines 10, 20 and 50 POKE the initial values required into the system variables, but these addresses needn't be accessed again in Basic. Lines 30, 40 and 60 POKE the variables which you *are* allowed to PEEK and POKE throughout the game. Lines 70 and 80 are 'the game'. The machine code will only move the figure by *one square*, if at all, and so *between* these moves you can put whatever you want, and this will define the game.

TRICK OR TREAT?

There is one other trick worth knowing about (one that in a way contradicts what was said earlier). The following subroutine will STOP the figure from falling down again after jumping and should be called whilst the player is in mid-air:

```
1000 POKE 23726, PEEK 23724
1010 POKE 23728,0
1020 POKE 23729,0
1030 RETURN
```

Happy programming — may silliness reign supreme! □


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THE PROTECTION RACKET

Have you ever wondered how professional software writers 'protect' their programs from copying and alteration?* Simon Goodwin *chews over some of the techniques used on the Spectrum, and outlines ways in which these same principles could be incorporated in your own software.

The first problem of program protection comes when a tape has just loaded. Obviously you don't want the user to type SAVE and produce a new copy — but how can your program take over control of the computer?

Ideally the program will start as soon as it's loaded. On the Spectrum this is quite easily achieved from Basic. If the word LINE is added to the end of the SAVE command, a Basic program will automatically start to run as soon as it's loaded, without the need for the user to type anything. The command SAVE "EXAMPLE" LINE 200 would save a Basic program which will RUN as soon as it has been LOADed. There is a snag, though.

The Spectrum LOAD command is not the only way to read a Basic program into the machine. Sinclair Research provides a MERGE instruction, which fetches a program from tape and then combines its lines with those which were already in the computer. The MERGE command never RUNs a program after it has been loaded, even if the program was saved using the LINE instruction. Consequently, the danger is that it's possible to break into, and list, any Basic program which would normally RUN straight away. Sinclair Research recognised this flaw when the Microdrive was designed — you can't MERGE a Microdrive file which has been saved with the LINE option, although the flaw in the tape system has not been corrected.

All anyone has to do is simply type NEW (so that there are no lines already in the computer) and " " to load the 'protected' program. Once it has loaded there'll be the normal 'OK' message. Finally, typing LIST will enable anyone to examine the program, regardless of any 'anti-break' mechanisms in it. It's a technique that, unfortunately, allows people to intercept the program before it has time to set up protection against STOP or BREAK.



JOE WRIGHT

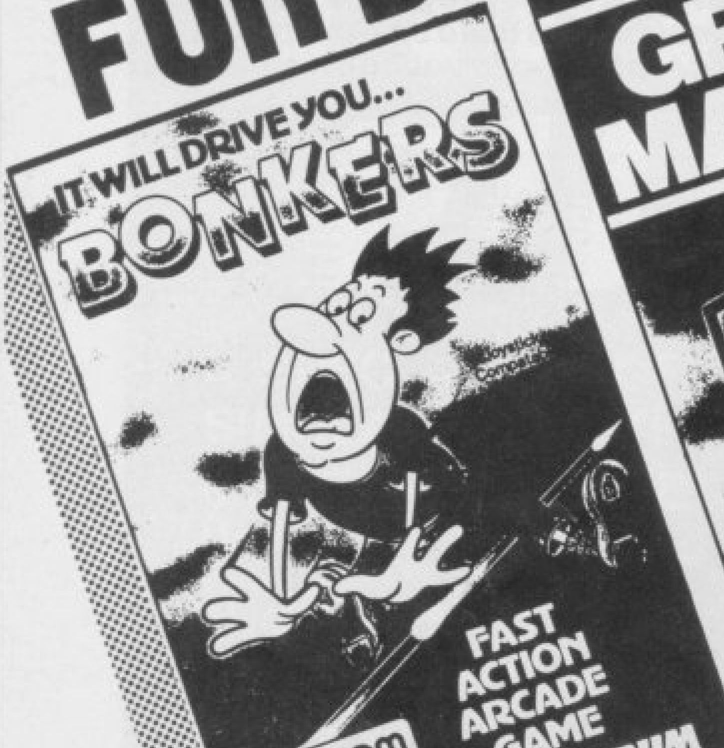
At first sight SAVE "?" LINE would seem to be the only way to produce a Spectrum program which will RUN as soon as it is loaded — but experience in the shops will show that this is not the case.

Some programs are able to 'auto-RUN' even though they are saved as machine code blocks of memory. The Spectrum allows users to record the contents of any area of memory with the command SAVE "NAME" CODE START, LENGTH. NAME is the name of the tape file and START and LENGTH are the first address of the memory and the number of bytes it contains, respectively.

It is possible to use this command to SAVE any area of memory. If you saved the entire contents of the Spectrum RAM you would be able to save a kind of 'picture' of the state of the computer — since all of the information saved would correspond to the exact state of the computer when the SAVE command was executed. If you then loaded that 'picture' back you would overwrite everything that had been done since the SAVE was carried out. In effect, you would restore the computer to its state when the SAVE was underway.

The Spectrum stores Basic in an area of memory, just as it stores everything else! The computer also uses 180 bytes of memory to store a description of the current Basic program, including notes on which variables are being used, what line is being executed, and so on. The program below saves itself as a CODE area, while the Basic is running. RUN it — it will save itself and then print a message. Then reset the computer (either by typing RANDOMIZE USR0 or by pulling out the plug). When you load what was saved, you will find that the

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EMS

Basic will pick up just where it left off. Let's see it:

```
100 PRINT "This appears before the SAVE!"
110 SAVE "DEMO" CODE 23552,1500
120 PRINT "The program goes on. . .";
130 GO TO 120
```

Now we have found a new way of making a Basic program RUN as soon as it is loaded. Of course, we could have started some machine code instead if we had put an appropriate USR call (to the first part of the code) on line 120. The advantage of this technique over SAVE "?" LINE is that you can't disable it with a MERGE instruction. In fact both of these techniques are used quite commonly in commercial software.

There is one other bonus of saving programs as CODE rather than Basic. If you replace the value 23552 with 16384 in line 110, you will create a single file which contains both Basic and the display picture at the moment of the SAVE. This combined file will load more quickly than two separate 'screen' and 'program' files. The only snag is that you have to save the contents of the printer buffer (256 bytes) since that is sandwiched in memory between the 'screen' storage and the Basic.

Unfortunately, it is still possible to break into a program saved as CODE, but it's rather more difficult, especially if the program is a long one. The LOAD " " CODE command allows you to specify a new load address for the taped program, so that you can stop it taking over by loading it into an area of memory where it will not overwrite your loader. This is obviously not easy on a 16K Spectrum.

Another snag of using SAVE "?" CODE rather than SAVE "?" LINE is that the VERIFY command doesn't usually succeed when you try to check the CODE block, even if the SAVE was perfectly successful. This is because our 'picture' saves a few values which are constantly changing without harm to the Basic (the time, for instance) so that VERIFY will find that the file on tape is almost always different from the contents of the memory it came from.

Some software publishers use the three byte internal timer of the Spectrum as a way of detecting whether or not a program has been meddled with — they set the time to a fixed value when the program is saved, and then check for that value when the program runs. If there is a discrepancy of more than a few seconds the program self-destructs!

At least the usual way to foil such protection is rather long-winded. You have to break into the program once it has loaded and find the code which checks the time (search for the value 32673 in memory). Next, you need to examine the code using a disassembler, and disable it by altering or skipping it. Chapter 18 of the Spectrum manual contains a good example of the use of the timer.

KEEPING CONTROL

We've shown how it's possible to take over control of the computer during a LOAD. But how can a program keep control after the LOAD is complete?

If we aim to stop the user from saving a copy of our program, we must obviously make it impossible for him or her to get back to the 'OK' prompt, from which a SAVE command could be issued. Normally Basic checks the keyboard 50 times every second, to find out whether or not the Break key is pressed (among other things). We can stop this check quite easily by turning off the Spectrum's 'real time clock' which tells the computer when to examine the keys. Here's how:

```
100 POKE 23296,243
110 POKE 23297,201
120 RANDOMIZE USR 23296
```

This short program clobbers the Spectrum's clock. It temporarily stores a tiny machine code program in the computer's printer buffer, and then the two machine code instructions are carried out. The first one turns off the clock (243, Disable Interrupts) and the second one returns the user to Basic.



The snag is that the Spectrum needs the clock to survive! If you run the above program you'll find that the computer 'hangs up' (ignores you) as soon as the machine code has been executed. Without the clock, the Spectrum doesn't look at the keys. The INKEY$ function will still work, but INPUT is disabled. You can't enter any more instructions after the clock has been turned off. Add these lines to the program to turn off the clock before you type RUN, and you will find out the snag:

```
130 PRINT INKEY$
140 GO TO 130
```

If you type BREAK, the computer will stop dead. It's waiting for another 'tick' — but will never hear one, because you've turned off the clock. Disconnect your computer and then plug it back in (be careful with the 9 volt socket, which can become loose with age). Now try to use an INPUT statement after the clock has been turned off.

This technique has other flaws. The clock is temporarily turned off during instructions such as BEEP and SAVE (otherwise you would hear a ragged sound as the computer keeps stopping to look at the keyboard). Likewise the COPY command turns off the clock temporarily, so that the printer can be served quickly, without interruption. All of these commands turn the clock back on once they have finished — you cannot use them in a program which is designed to work with the clock turned off.

The main advantage of running a program with the clock off is that it will work slightly faster, since the computer no longer has to check the keyboard 50 times a second. In practice, the advantage is not very great. However, this technique of protection is used in quite a few programs.

SOME FATAL ERRORS

So, another approach is needed to the problem and one interesting idea is to try to alter the way the computer treats 'errors'. The Spectrum classifies use of the Break key or a STOP statement as error, which means that every situation which leaves the user able to type a command such as SAVE is an error. But is it possible to 'intercept' the error before the computer gives the user the chance to SAVE?

Close examination of the Spectrum manual and ROM indicates that all errors are treated in a special way. The computer fetches an address from locations 23613-4 (called ERR-SP in the manual). That address is, in turn, the address of another location in memory. Next, the computer fetches the value in that location, and carries out a machine code GO TO to the address indicated!

This is a rather tangled route, but it allows the computer to get out of an error without losing track of its memory. The mechanism is quite complicated, but it all hinges on the value in locations 23613 and 23614. If we alter those values, we alter the way the Spectrum treats an error.

The next program example forces the Spectrum to jump to location zero whenever an error occurs. If you run the program you'll find that the computer resets itself — destroying the program — as soon as you type BREAK. Here it is:

```
100 POKE 23613,2
110 POKE 23614,91
120 POKE 23298,0
130 POKE 23299,0
140 PRINT "?";
150 GO TO 140
```

The program forces Basic to look at addresses 23298 and 23299 — the printer buffer, once again — whenever an error occurs. The computer jumps to the address specified at the start of the buffer when the error is detected. We've specified the address 0 (lines 120 and 130) so that the machine jumps to address 0, the beginning of the ROM, and promptly behaves as if it has just been turned on, scrubbing the program in the process!

In principle, you can alter the program to carry out any other option when

the Break key is pressed. Alter line 130 to:

```
130 POKE 23299,127
```

and the computer will jump to address 32512 (127 times 256 plus 0) when an error is found. If you don't want to put the address in the printer buffer you can alter the POKEs in lines 100 and 110 so that they specify a different address. At the moment they 'point' to 91 times 256 plus 2, which is 23298 — part of the printer buffer.

If you always want an error to result in a system reset, you can point at a part of the ROM which always contains the address 0. The following example illustrates a simplified routine:

```
100 POKE 23613,4
110 POKE 23614,61
```

These two POKEs will force the computer to reset itself whenever it would otherwise have produced an error message.

Unfortunately, there is a snag with this method of protection. Basic obviously has its own use for the value in ERR-SP. Sometimes the Spectrum will alter the value, removing your protection system. The RUN, CLEAR, GOSUB and RETURN commands all change the value of ERR-SP, so that you cannot use any of them in programs which disable BREAK in this manner. The technique is consequently not much use in complex programs, although it is quite a good way of protecting short routines which call machine code.

DISPLAY DISMAY

There is another way of protecting programs which doesn't suffer from this problem, although it brings other difficulties of its own.

The Spectrum is an unusual computer in that it splits its display into two areas — the text or graphics area at the top of the screen, and the so-called edit area at the bottom — used for commands, error messages and editing. Each area is treated separately by Basic. If we can stop the computer using the edit area we will be able to stop all modifications and commands.

Luckily the Spectrum manual contains all the information we need to do this. Location 23659, unmemorably called DF-SZ, is used to record the number of lines in the edit area of the screen. This is normally two or more, which is why you can only plot on 176 lines of the Spectrum display, even though there are 192 lines there. In fact, 16 plot lines (enough for two lines of characters) are reserved for the edit area.

When the Spectrum ROM was written, the authors presumably noted that the edit area is never completely empty (zero lines) and programmed accordingly. That was a resonable assumption to make, and consequently the ROM doesn't check for the case of zero lines.

If we put the statement POKE 23659,0 in a program, we are telling the computer that the edit area is zero lines long. If we try to write into the edit area after that, the computer becomes confused — there are no free lines for the message. The consequence is that the computer hangs — it just sits there, impervious to the user's attempts to disturb it.

Earlier we said that all error messages are printed in the edit area of the screen. After POKE 23659,0 the edit area does not exist, so there is nowhere for the message to be printed. Any attempt to break from a program protected in this way results in the screen being cleared (a side effect of the way the computer tries to tackle the problem) and then the computer hangs.

The only flaw of this system is that it disables the Basic commands CLS and BORDER. You probably know that the command OUT 254,2 has a similar



effect to that of BORDER 2. The OUT command passes the colour code 2 (or any other value 0-7) to the Spectrum ULA, where it is used to specify the colour of the screen border. The difference between this and the BORDER command is that BORDER also controls the colour of the edit area. A BORDER statement issues an OUT command and then colours in the edit area in the same colour as the perimeter of the screen. Finally it stores the new colour in RAM so that subsequent communication with the ULA (reading the keys, for example) will not suddenly change the colour of the border of the display.

The BORDER statement consequently tries to write to the edit area of the screen. If we use BORDER after POKE 23659,0 the computer will hang when it tries to write to the bottom of the screen. Likewise the CLS command clears both parts of the display, writing to the edit area in the process. Thus, we can't use CLS and POKE 23659,0 together.

Luckily it's quite easy to write Basic or machine code subroutines to simulate BORDER and CLS. Our next program example shows how this can be done. Use GOSUB 8000 instead of CLS, and GOSUB 8100 for BORDER. The CLS routine uses the values of INK and PAPER selected earlier. Adjust the value of the variable BORD to select a border colour. Let's take a look:

```
8000 OVER 0 : INVERSE 0
8010 FOR Y=0 TO 21
8020 PRINT AT Y,0,,
8030 NEXT Y
8040 RETURN
8100 LET C=BORD*8
8110 FOR Y=23232 TO 23295
8120 POKE Y,C
8130 NEXT Y
8140 OUT 254,BORD
8150 IF C<=32 THEN LET C=C+7
8160 POKE 23624,C
8170 RETURN
```

The first subroutine is quite simple — it overwrites every line of the display with a blank space in the current colour. Each comma at the end of line 8020 tells the computer to output 16 spaces. Consequently two commas produce 32 spaces, clearing an entire line. The subroutine only alters the top 22 lines (those normally available to the Basic programmer).

The second subroutine is a little more complex. It begins by converting the border colour into the form used in the computer's attributes table, where the PAPER colour is a multiple of eight. Then the appropriate value is stored in the 64 locations which contain the attributes of the lower two lines of the Spectrum display. This will be the entire edit area,unless you typed RUN immediately after editing and deleting a long program line.

The next step is to change the colour of the border. Line 8140 sends the new value to the ULA. Finally we must put the border colour in the computer's working storage. Location 23624 (called BORDCR) is the place reserved for this information by the Spectrum ROM. Line 8160 ensures that the computer does not change the border colour back again as soon as it next communicates with the ULA.

We now have another practical way of protecting a Spectrum program from interruption. This scheme is also popular with professional software authors.

COPY TECHNIQUES

The publishing industry regularly gets upset about the ease with which books and magazines can be photocopied for a fraction of their proper prices. The software industry suffers from similar problems, although the mechanism used for copying is quite different (have you ever wished you could photocopy a cassette or floppy disk?). There are two ways of duplicating software — dubbing and bit-copying.

Dubbing is a simple process which should be familiar to all readers. You simply take two tape recorders and connect them together, playing the original tape and recording direct on to the duplicate. Dubbing is simple, cheap and totally undefeatable. There is no

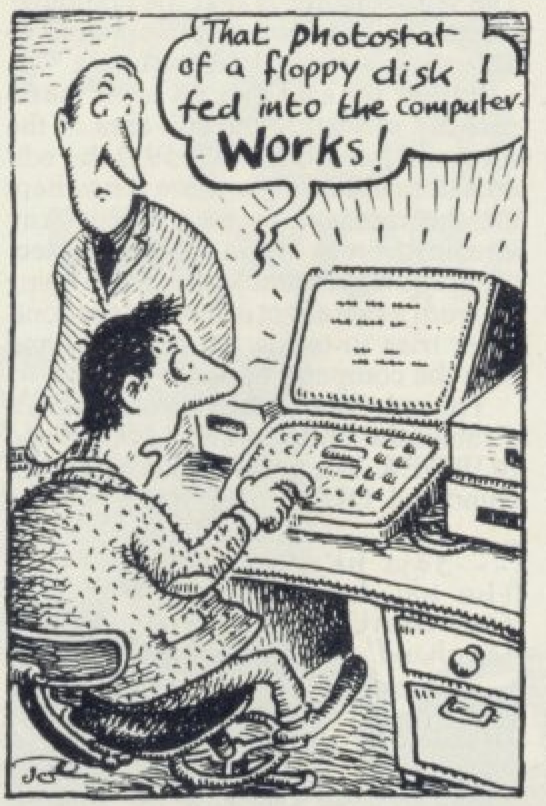
way to stop people dubbing cassette software, so long as the software can be played back on a standard recorder. If there was, be sure the record companies would have found it by now!

The disadvantage of dubbing is that it's not very reliable. A copy is of worse quality than the master — the original hiss and distortion has been duplicated and new distortion has been added. One educational software supplier in Birmingham has carried out experiments to determine how often a tape can be dubbed before it becomes unusable. Even good-quality recorders failed to produce loadable tapes after the third 'generation' of dubbing.

A bit-copier is a program that reads data from a tape without interpreting it in any way. Programs are saved as a succession of musical tones on a cassette. The tones, or their lengths, vary to signify a '1' bit or a '0'. Almost every computer uses different tones or lengths, which is the main reason why computers can't begin to make sense of each other's tapes.

The first bits on the tape usually determine the type of file, its name, where to load it, and so on. The data to be stored then follows, interspersed with other information such as 'checksums' (the total of bits so far, used to check for loading errors) and other marker information. A bit copier ignores the significance of all of this information. It just reserves a large buffer of memory, and stores bits in the buffer as they are read from tape. Once the entire file is stored it can be squirted out just as it was read.

Such a copier can make an infinite number of generations of copy, since



each duplicate is identical to the original. They pose a much greater threat to software publishers than dubbing, since they make it possible for enormous numbers of illegal copies of a program to be produced. Luckily it's easy to defeat a bit copier, although surprise to say the combined brains of the UK software industry don't seem to have worked out how.

A bit copier for a Spectrum won't copy BBC Micro programs — the tones and timings are different, so that the copier would read (say) pairs and triplets of 3.4s and 11s rather than individual 1s and 0s. A program to copy *any* tape would need to store detailed timing information about each click encountered. Such a program is impractical, requiring very large amounts of memory to copy even a short file.

To fool a bit copier all you need do is store part of your file in a non-standard format. Use different tones or timings. The first part of the file is formatted the usual way, so that the computer can load it. Besides various blind alleys and tricks, it contains a devious program to read the rest.

The only way to make a bit-copy of the whole file is to decode the first part and discover exactly how it works, then write a new copier for the rest of the data. That is hard work — more than £5 or even £50 worth of work. Anyone who can do it would be better off selling his or her skills and buying software, rather than duplicating it!

TO CONCLUDE

Complex and costly though it is, it seems that software protection is here to stay. The techniques involved indicate one of the most fascinating aspects of programming — how to alter the fundamental behaviour of a computer. ■



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SOFT ROM

Developing a range of software 'goodies', Timedata's Mike Lord divulges the secret of the SoftROM — the circuit which made it all possible.

As anyone who has used machine language will understand, it's a darn sight easier to find out what a machine code routine is doing if you can make temporary changes to it; by adding breakpoints for example, or by jumping into the middle of a routine, or returning prematurely from it. And so, from a desire to change the contents of the Spectrum's ROM, combined with the knowledge that the contents of a ROM are fixed for ever when the chip is manufactured, came the idea for *SoftROM* — a hardware add-on containing 16K bytes of RAM which can be controlled by a switch to operate in two modes.

In the 'normal' mode, the RAM is located in the low 16K bytes of the Spectrum's address space — where the ROM resides — but only appears when data is written to it. Any data that is read from this area will come from the ROM, so the Spectrum will behave normally. In *SoftROM* mode, however, the Spectrum's ROM is disabled completely, and any read or write to locations in the first 16K will be to the added RAM.

With this add-on in the 'normal' mode, you can copy the contents of the ROM into the corresponding RAM locations. This done, you can then switch to *SoftROM* mode, and the Spectrum should carry on running exactly as it does normally, except that the Basic interpreter, operating system, character dot patterns, and all of the other intriguing routines are now in RAM — there for you to mess with as you will! You might even care to try correcting the known 'bugs' in the Spectrum ROM!

Another use of *SoftROM* would be in developing large machine code programs that entirely replace the Spectrum's ROM and which would eventually be put into EPROM or even a cartridge that plugs into the Interface II unit. Or alternatively, for the really ambitious who are also able to add a floppy disk drive to their Spectrum, *SoftROM* could be used to implement the CPM operating system, which needs RAM in the area normally occupied by the Spectrum's ROM.

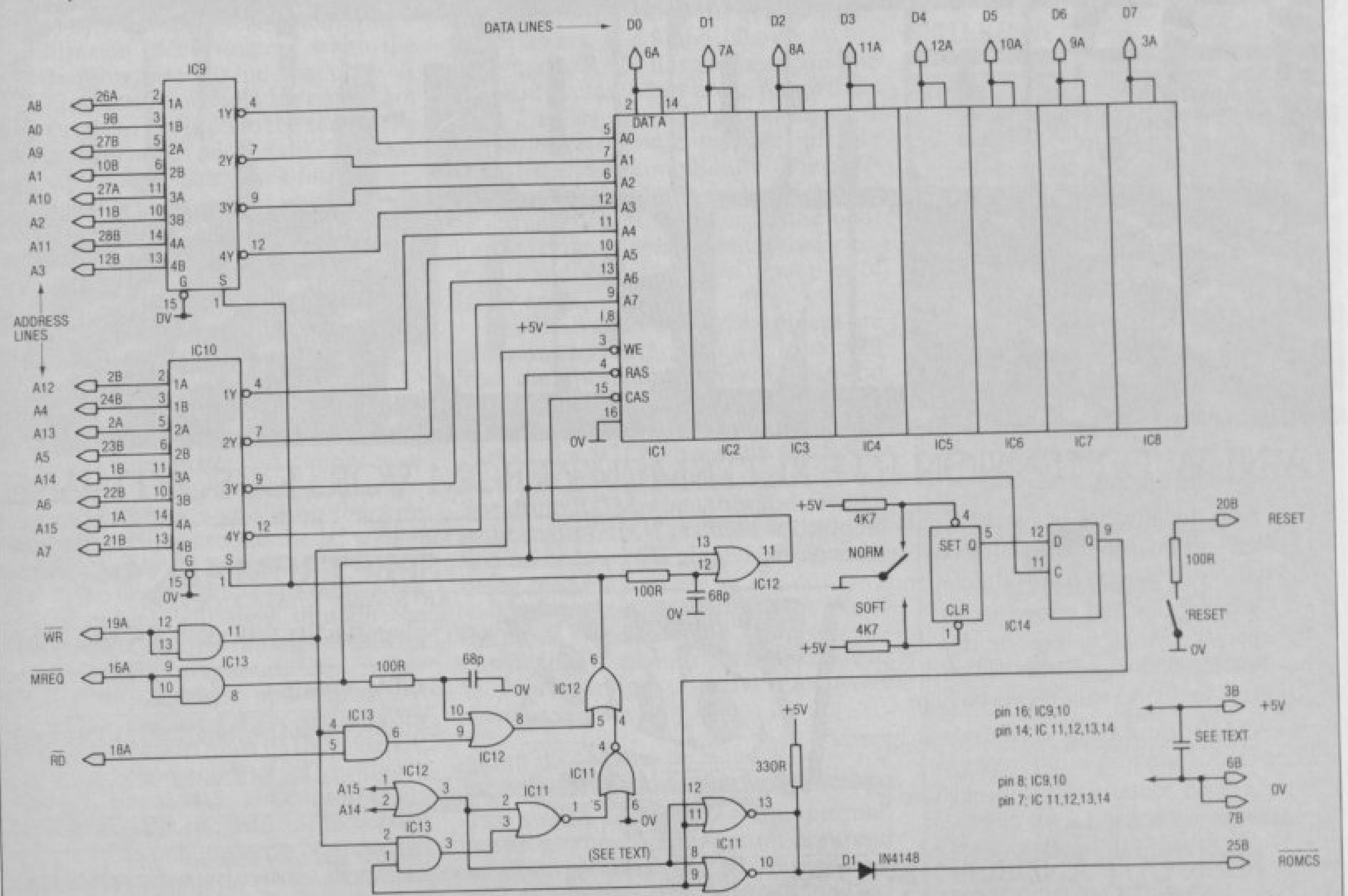
But for those of more modest means, the *SoftROM* circuit can also be used as a normal memory extension add-on, hoisting the 16K Spectrum up to 48K. To do this, all that's necessary is to fit 64K x 1 RAM ICs (4164s) in place of the 16K x 1 types (8118, 4816) and connect pin 6 of IC11 to the Spectrum's address line A15 instead of to 0V. The *SoftROM* board will then contain 64K bytes of RAM, 16K of which are used for the *SoftROM* function, 32K to extend the Spectrum's RAM, and 16K which will not be used at all. Do this and the 32K bytes extension will always be present, regardless of the position of the *SoftROM* mode switch.

One other 'enhancement' is the addition of a push-button Reset switch. Operating this triggers the Spectrum's power-on reset circuit and is guaranteed to get you out of the most horrendous 'crashes' without having to cut the power.

BUILDING THE BEAST

Because of the large number of connections to be made and the potential dif-

The Spectrum SoftROM Circuit



Mike Lord's favourite method of construction for this type of circuit is to build everything on a piece of bar veroboard to which a 28 + 28 way Spectrum edge connector can be Araldited.



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SOFT ROM

ficulty in tracing faults (it either works properly or not at all!), this project is only really suitable for the experienced constructor. Which means that if you are at all doubtful about your 'hot rod' skills with a soldering iron, then find a friend who is both willing and able — 'nuff said!

One peculiarity of dynamic memory ICs is that they draw large, fast, spikes of current from the supply rails when they are strobed. If the supply rails are not 'solid' and thoroughly decoupled, then the voltages developed by these current spikes flowing along even an inch or two of wire can be enough to upset things. For this reason, the RAM ICs should be mounted as close together as possible to minimise the lengths of the supply lines, and a small (10nF to 100nF) decoupling capacitor should be connected directly between pins 8 and 16 of each RAM IC, again keeping the lead lengths as short as possible. Another two or three capacitors should be fitted between the supply rails near ICs 9-14.

The author's favourite method of construction for this type of circuit is to build everything on a piece of bar veroboard to which a 28+28 way Spectrum edge connector socket can be Araldited. This socket must be fitted with a polarising key in position 5 to prevent the possible disaster of mis-mating when the board is plugged in to the Spectrum. A matching double-sided edge connector plug strip can be fitted to the rear of the board so that other add-ons like printers can hop aboard, piggyback fashion.

IC sockets, preferably with sturdy pins, are then glued on to the veroboard, then the 0V and +5V supply lines wired in using a reasonably heavy gauge wire. To keep noise to a minimum, the 0V line should be laid out in the form of a 'grid' so that the 0V connections between ICs are kept short.

The signal wiring can then be carried out by way of the 'verowire' system. This uses thin enamelled copper wire fed from a handy pen-type tool. To make a connection you wrap the wire two or three times round the IC socket pin, then apply solder and a fine-tipped iron in the normal way. The heat of the molten solder will melt through the enamel insulation on the wire to make a good joint. This may sound like a rather dubious way of wiring up a circuit, but the author has used it successfully for many years, and it must be the cheapest and most compact way of making a 'one-off' board. It's also surprisingly reliable and not too difficult to correct errors or make changes to a board wired in this way.

Finally, before plugging it in to your precious Spectrum, make absolutely sure that there are no accidental short-circuits between the supply rails and any other of the Spectrum connector pins.

HOW IT ALL WORKS

The throbbing heart of the circuit is the bank of eight RAM chips, IC1-8. These are 16K bit (or 64K if the board is also to act as a memory expansion unit) dynamic memories, so eight are needed to provide the full 16K (or 64K) bytes, one chip being connected to each of the Spectrum's eight data lines.

As with all dynamic RAM ICs, they need two strobe pulses, RAS and CAS, and their address inputs are 'multiplexed'. That is, the address signals needed to select one of the 16K (64K) bits are fed to the address inputs of the chip in two stages; half when the RAS line is pulsed, then the remaining half when the CAS line is pulsed. The selection of which half of the Spectrum's address lines are to be connected to the RAM chips is done by the quad 2-input multiplexers, ICs 9 and 10.

"For the really ambitions, SoftROM could be used to implement the CP/M operating system."

Dynamic RAM ICs also need periodic 'refresh' cycles if they are to retain their data. Luckily, the Z80 processor used on the Spectrum can provide suitable refresh cycles automatically. The *SoftROM* circuit has been designed to take advantage of this, resulting in the odd-looking order of connection of the Spectrum's address lines to the input pins of ICs 9 and 10.

The RAS and CAS strobe pulses are generated by parts of ICs 11, 12 and 13 from the Spectrum's WR, MREQ and RD outputs whenever a read or write operation is to be done to the *SoftROM*. Part of the IC11 also pulls the Spectrum's ROMCS line high to disable the Spectrum ROM when the mode switch is in the *SoftROM* position and a location in the low 16K of memory space is being read from.

IC14 ensures a 'clean' operation of the mode switch by only letting the circuit change from one operating mode to the other during the dead time between memory accesses.

USING IT

The switch should be in the 'normal' position when the Spectrum is turned on, so that everything powers up normally. The next step is then to load the *SoftROM* with something sensible. Those wanting to experiment with the Spectrum ROM routines will find the easiest thing to do is to copy the ROM contents directly into RAM, which can be done with a Basic program such as:

```
10 FOR=0 TO 16383
20 POKE A, PEEK A
30 NEXT A
```

This takes a minute or two to run, so you impatient types may now try writing an equivalent machine code routine to do the job in a fraction of a second.

Once the data has been copied, then it's just a matter of flicking the switch over to run from RAM. And you could also load data into the *SoftROM* from tape, with a command such as:

```
LOAD "SUPERROM" CODE
```

and the switch in the 'normal' mode — provided that you had previously saved the data on to tape with:

```
SAVE "SUPERROM" CODE 0,16384
```

Once in *SoftROM* mode, you can examine and change values with the Basic PEEK and POKE statements, or even use a machine code monitor program such as Picturesque's to set breakpoints, modify, and run parts of the code. But some thought is needed when you do this. The routines you modify may be the very ones that are used to enter data or display the results and with bad luck it's possible to 'crash' the system in some really spectacular ways! Although it's impossible to do any damage to your Spectrum, it *is* easy to get into a position where the only way to recover is by switching to 'normal' mode and re-setting the system.

YOU'LL NEED...

IC1-8	16K x 1 5V dynamic RAM : (4816 or 8118) or 64K x 1 (4164), see text. (Any speed RAM chips will work.)
IC9,10	74LS158
IC11	74LS02
IC12	74LS32
IC13	74LS08
IC14	74LS74

10 off 16-pin IC sockets
4 off 14-pin IC sockets

2 off 100R 1/4W 5% resistors
1 off 330R 1/4W 5% resistors
3 off 4k7 1/4W 5% resistors

1 off diode 1N4148

1 off push button switch, single pole normally open.

1 off toggle or slide switch, single pole double throw.

10 off small decoupling capacitors, 10nF to 100nF.

28+28 way 0.1 inch double-sided edge connector socket with polarising key in position 5.

Veroboard, wire, solder, etc.

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See 48/80 FORTH for another angle.

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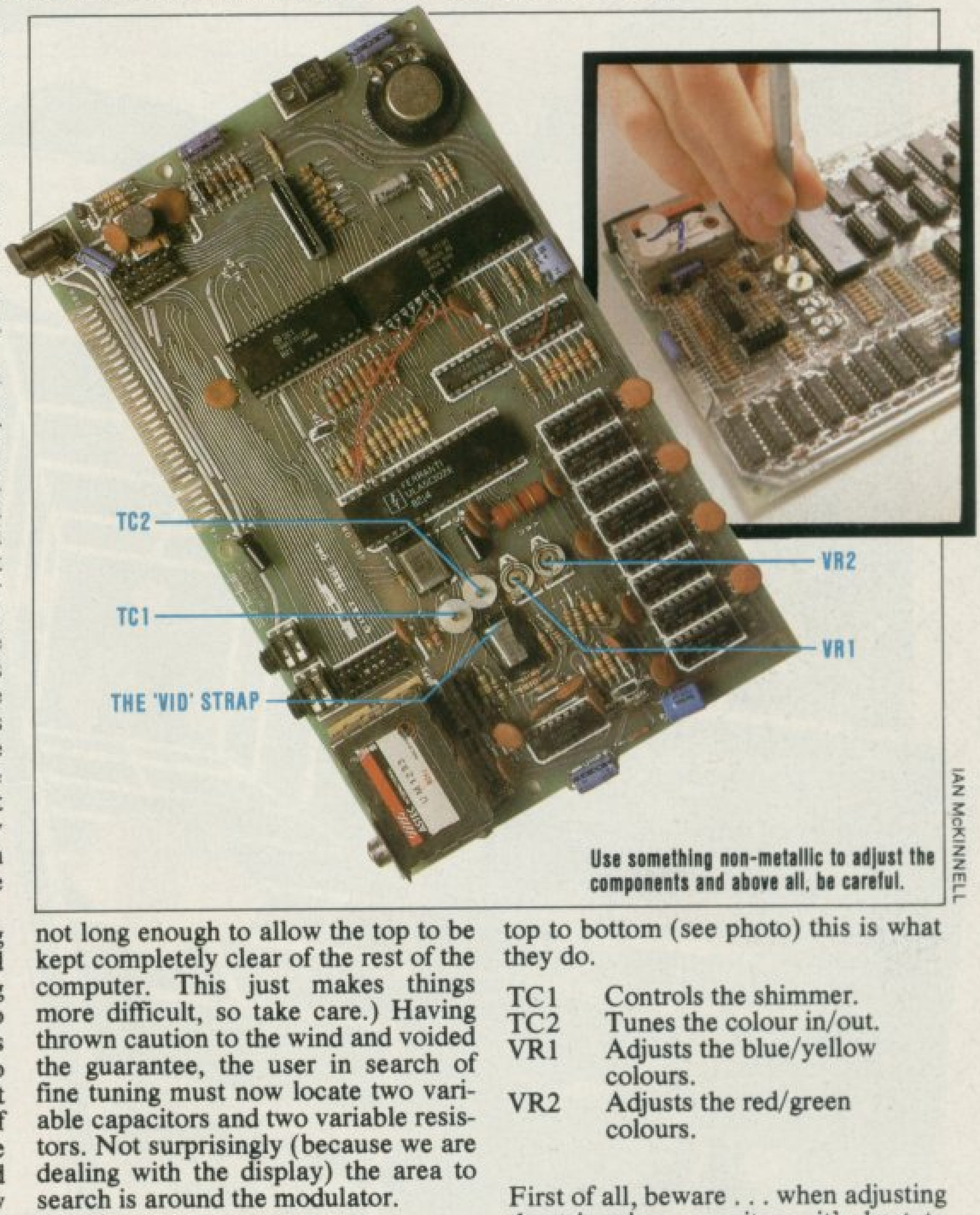
EAST LONDON ROBOTICS

TUNING UP YOUR SPECTRUM

How do you get the best possible picture on your television from the Spectrum's video output — or even more tricky, on a monitor? Ian Beardsmore completes the picture, and at the same time introduces a forum for readers to knock around ideas.

One of the idiosyncrasies of our beloved Spectrum, at least of the Issue 1 and 2 models, lies in the flexibility of the display. So far as the vast majority of Spectrum owners are concerned, their computer is not compatible with a monitor. Indeed, the machine will not even be compatible with some home televisions! Only the smug owners of Issue 3s are unaffected by these problems (although they may instead have trouble running some early software).

It's quite common to see Spectrum owners walking around Microfairs looking mystified at the sight of their computers doing the impossible: Spectrums on display being used with Toshiba televisions, and some even linked to the usually unusable Hitachi 14-inch colour portable. In the worst case of impossibility, a Spectrum may even be seen connected to a monitor. The more clued-up amongst us will be able to guess correctly that computers in this latter category have had the same modification as those Spectrums that entered schools under the 'Micros in Education' scheme. Fine for those in the know, but how about Joe User? "What the heck" you may think, "the Spectrum is a good enough bargain as it is". But if so, why the Issue 3?



Use something non-metallic to adjust the components and above all, be careful.

IAN McKINNELL

Probably the most frustrating aspect of all this is that published solutions are not readily forthcoming — even though the 'experts' seem to make the necessary modifications with consumate ease, thus leading to even greater feelings of alienation. But relief is at hand because, in point of fact, the necessary changes are actually quite straightforward, and certainly within the capabilities of any careful Spectrum owner. Of course, there is a catch. Anyone taking the lid off their Spectrum will void the guarantee! So, what you decide to do at this point is up to you. But let us assume a reckless streak has suddenly plunged into the otherwise calm breast of a dedicated user.

What would happen? How would our hero (or heroine) progress? First, of course, the top will have to be unscrewed, then lifted off. (This, in fact, is connected to the printed circuit board by two ribbon cables that are not long enough to allow the top to be kept completely clear of the rest of the computer. This just makes things more difficult, so take care.) Having thrown caution to the wind and voided the guarantee, the user in search of fine tuning must now locate two variable capacitors and two variable resistors. Not surprisingly (because we are dealing with the display) the area to search is around the modulator.

FINE TUNING 'TWEAKS'

There are several components worth knowing about in our quest to re-tune the machine to a particular television. And also to be found in this general area is the 'VID' strap, something that will need dealing with if the computer is to be used with a monitor. But more on that later because currently we are interested in the trimming capacitors, TC1 and TC2, and the variable resistors, VR1 and VR2. Working from top to bottom (see photo) this is what they do.

TC1	Controls the shimmer.
TC2	Tunes the colour in/out.
VR1	Adjusts the blue/yellow colours.
VR2	Adjusts the red/green colours.

First of all, beware . . . when adjusting the trimming capacitors, it's best to use something non-metallic to adjust them with. A matchstick cut to shape is quite suitable. And, of course, added care should be take anyway because all adjustments have to be made while the computer is turned on — so that the results of 'tweaking' can be seen on the screen.

To begin with, adjust the screw in TC2 carefully in both directions until you find the point of strongest colour — even if this is still too weak. That done, try bringing up the blue/yellow

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end of the colour range by adjusting VR1. Once you've found the best colour here, bring in VR2 and tune in the red/green end of the colour spectrum. Essentially, what you need to do is balance those three components for the best picture. Again, the watchword is care and, as a precaution, it might be wise to take note of the pre-adjustment settings of the three variable components.

TC1 is the capacitor which controls the shimmer on the screen. Once the colour is as you want it, then this ought to be the final adjustment you make. One thing, however, is that sometimes shimmer can interfere with a viewer's perception of the other colours. It may be that further tiny adjustments of the first three will be needed, once changes have been made to TC1. Complete this juggling act and you should have your Spectrum finely tuned to a particular television.

THE MONITOR SOLUTION

So far so good for the person who is only interested in re-trimming the computer to another television. However, those thinking of greater things will first need to lash out on a monitor that accepts a composite video input, and then be prepared to do a simple soldering job.

Below the modulator, and just to the left of the gap between TC1 and TC2, there is a small white line marked 'VID'. At one end of this is a small solder point, and at the other, the hole of a through-the-board connection point. In fact, it's not quite as easy as it may seem to access this line because of the line of resistors that stretch out below the modulator.

'VID', in fact, marks a break in the video line between the modulator and the expansion port. Obviously, as there is a break in the line, the signal cannot reach the port; therefore, all you need to do is bridge this gap. How you accomplish this feat is up to you. The simplest (and nastiest) way is to stretch a blob of solder between the solder point and the hole. A short piece of wire is better, but for more ease a longer piece can be used. Whichever way, once done you will have a composite video signal available at the port.

Only two lines are involved at the port, the video line and the 0 volt line. These are placed next to each other, on the middle underside of the port. At the input end, where it enters the monitor, the video line goes to the central pin while the 0 volt line goes to the case. If you want you can adapt the UHF line supplied for use with a normal television. Otherwise, any electrical shop should have what's needed.

All that remains now is to decide how to take the video line from the port. The most flexible way would be to use a connector and motherboard. On the other hand, it's also possible to take the lines from another port — for example, if you have the printer always connected, this could be used instead. However, be careful here because with some programs, if the printer is left connected, you get a screen dump. Those going as far as a monitor are, on balance, recommended to invest in a connector especially for it.

COMING SOON

Despite this issue's content, don't run away with the idea that *Spectrolysis* has necessarily to be a hardware section. In fact, the intention really is to create a forum for information exchange about the Spectrum. Anyone with a particular problem (software or hardware) — or those who have discovered some interesting application, or perhaps a routine without an obvious application, or maybe just the solution to someone else's problem — whatever — are all welcome to write in.□

Just drop a line to me, *Ian Beardsmore, c/o Your Spectrum, 14 Rathbone Place, London W1P 1DE.*

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THOSE MOODY MICRODRIVES

The ZX Microdrives are with us, or at least some of us, and have a great deal to offer at a low cost. Unfortunately, there are one or two problems, not least of which are a couple of bugs in the Microdrive ROM.* Andrew Pennell *presents three short machine code routines to circumvent the major traumas.

While there's plenty to recommend about Sinclair Research's elusive Microdrive device, as with most innovations there's room for improvement. The first part of this article is for all users and explains the problems and tells how to use the 'cures'; and the second part is for those who know some machine code and who appreciate fuller explanations.

Before presenting the listings, here is a very useful feature that can greatly decrease the loading times of some programs. Say you have a Basic program that loads another file — such as a SCREEN$ or some machine code. If you SAVE the Basic then SAVE the second file, there may well be a considerable delay when you re-load it between the Basic part, and the second file. This is because two files SAVEd directly after one another cannot usually LOAD directly after each other. To be sure of fast loading, after each SAVE, do a VERIFY, then the next SAVE, and so on. This method ensure minimum time taken for loading.

Figure 1 is a listing of a Basic program that contains all the data for the machine code routines; it's loaded into the printer buffer area of memory, at locations 23296-23353. However, the machine code is *position independent*, which means it can be put anywhere that's convenient in memory. Alternative places are the user-defined graphics area and above RAMTOP, and the start location can be altered by changing line 10 of the Basic listing. Do *not* put the code into a REM statement, ZX81 fashion — for technical reasons this is a very bad place to store Microdrive routines.

The first problem we're dealing with appears as a result of a serious bug in the ROM; this causes the machine to crash if there is insufficient memory space, and a LOAD *"m" or SAVE *"m" command is entered. The relevent Microdrive motor switches on, but no SAVEing or LOADing occurs, and you cannot halt the proceedings. The only way out is to remove the plug during rotation, something which might easily damage the cartridge. To get round the problem, before making such a command enter RANDOMIZE USR 23296 (or whatever the value of 'st' in line 10 has been made). If an 'Out of memory' error appears, it means that a SAVE or LOAD to Microdrive is dangerous, so don't try it. If no error message occurs, it means there is sufficient room and all such commands will be carried out.

Another problem can occur when you have a lot of OPENed streams. For each OPENED stream, a certain amount of memory is consumed, ranging from 11 to 595 bytes. The only way to get the use of all the memory is to CLOSE# or CLEAR#, but these sometimes fail to clear the memory, particularly if an error such as BREAK occurs during such a command. The second machine code routine, at st+8 (ie. 23304 if in the printer buffer), is designed to supplement the CLEAR# routine by removing any remaining memory areas of additional streams. Before using it, though, always do a CLEAR# first — for example, CLEAR#: RANDOMIZE USR 23304.

The final routine will prove extremely

```
   5 REM Printer buffer
  10 LET st=23296
  20 RESTORE 100
  30 FOR i=0 TO 57
  40 READ a: POKE i+st,a
  50 NEXT i
  60 REM test-room=st
  70 REM  clear#+ =st+8
  80 REM  collapse=st+41
  90 REM
  99 REM Test-Room
 100 DATA 207,49,1,147,2,195,5,3
1
 199 REM CLEAR# more
 200 DATA 17,240,92,42,79,92,229
,167,237,82,225,196,229,25,42,79
,92,17,20,0,25,235,42,83,92,43,2
6,254,128,196,229,25,201
 299 REM Collapse
 300 DATA 42,79,92,17,73,163,25,
208,33,240,92,17,182,92,195,229,
25
```

Figure 1. The Basic program containing the Microdrive 'cure-all'.

```
                10 ;        Test-room for
                20 ;        Microdrive commands
5B00            30          ORG  23296     ;printer buffer
5B00 CF         40 TESTRM   RST  8
5B01 31         50          DEFB #31       ;create extra system variables
5B02 019302     60          LD   BC,659    ;required space
5B05 C3051F     70          JP   #1F05     ;test-room
                80 ;
                90 ;        True CLEAR #
5B08 11F05C    100 CLEAR    LD   DE,23792
5B0B 2A4F5C    110          LD   HL,(CHANS)
5B0E E5        120          PUSH HL
5B0F A7        130          AND  A
5B10 ED52      140          SBC  HL,DE
5B12 E1        150          POP  HL
5B13 C4E519    160          CALL NZ,#19E5 ;reclaim maps if CHANS<>23792
5B16 2A4F5C    170          LD   HL,(CHANS)
5B19 111400    180          LD   DE,20
5B1C 19        190          ADD  HL,DE
5B1D EB        200          EX   DE,HL
5B1E 2A535C    210          LD   HL,(PROG)
5B21 2B        220          DEC  HL
5B22 1A        230          LD   A,(DE)
5B23 FE80      240          CP   #80
5B25 C4E519    250          CALL NZ,#19E5 ;reclaim channel bytes
5B28 C9        260          RET
               270 ;
               280 ;set constants
5C4F           290 CHANS    EQU  23631
5C53           300 PROG     EQU  23635
               310 ;
               320 ;
               330 ;COLLAPSE to remove extra system variables
5B29 2A4F5C    340 COLAPS   LD   HL,(CHANS)
5B2C 1149A3    350          LD   DE,#A349
5B2F 19        360          ADD  HL,DE
5B30 D0        370          RET  NC            ;return if no variables anyway
5B31 21F05C    380          LD   HL,#5CF0 ;end of area
5B34 11B65C    390          LD   DE,#5CB6 ;start of area
5B37 C3E519    400          JP   #19E5     ;reclaim the area
5B3A           410          END
```

Figure 2. The assembler listing of the three routines presented in Figure 1.

useful for converting certain cassette programs on to Microdrive, particularly those containing machine code in REM statements. Many commercial games contain such REM statements of this kind as the first line in a program, with subsequent commands such as RANDOMIZE USR23760. However, with Interface 1 in use, the location of the first line in a program can, and does, change — which normally makes the machine 'fall over' when it tries the USR statement. The third machine code routine starts at st+41 (23337 in the printer buffer) and removes the extra system variables; thus the first line will be in the same place as it would if there was no Interface 1 connected. Note that any error (except 'OK') and any Microdrive commands will move the line back to its previous position. Written originally for the game, *Valhalla*, the routine has proved useful on a number of other occasions too.

THE SECOND LEVEL

Those not understanding Z-80 machine code are likely to find the rest of this article something of a closed book — although, of course, you can still use the routines. *Figure 2* is the assembler listing of all the routines, and it was produced on the excellent HiSoft *GENS* assembler, which uses the unusual method of signifying hexadecimal numbers by preceeding them with '#'.

The first routine starts at TESTRM, and carries out a memory test that the Microdrive ROM doesn't quite get right. When doing a SAVE *"m" or LOAD *"m", a total of 659 free bytes are required, made up of 595 bytes for the CHANS buffer, 32 bytes for the Microdrive map, and 32 bytes for stack usage. Sad to say, the Interface 1 ROM only checks for 627 bytes — the ROM authors having overlooked the stack usage — thus causing the crash. The routine itself is quite straightforward. Firstly hook code #31 is used to make sure the 58 bytes of extra system variables are in existence, then the ROM routine at #1F05 is executed to test for 659 free bytes.

Before we discuss the CLEAR # supplementary routine, it would be useful to examine the relevent section of the Spectrum memory map – see *Figure 3*.

To remove all the extra memory areas after a CLEAR#, any Microdrive maps (plus any additional channel information) have to be reclaimed from the memory map, and everything above shifted down, while all the system pointers are altered. The ROM routine at #19E5 is designed to do just that, with the location of the first bytes to be reclaimed in DE, and the first location to be left alone in HL. The routine initially tests to see if CHANS is equal to 23792, and if it does not then any bytes in the Microdrive maps area are reclaimed. Then the byte at CHANS+20 is tested to see if it is the end marker of #80. If it is not then any extra channel information is reclaimed.

The third routine, COLAPS, firstly checks to see if CHANS is less than 23735, and returns if it is. If it is not then it means that the extra system variables exist; these are reclaimed, again using the ROM routine at #19E5. The 58 extra bytes are created by the Interface 1 whenever an error occurs, when an incorrect Basic line is entered, or when an Interface 1 command is entered. □

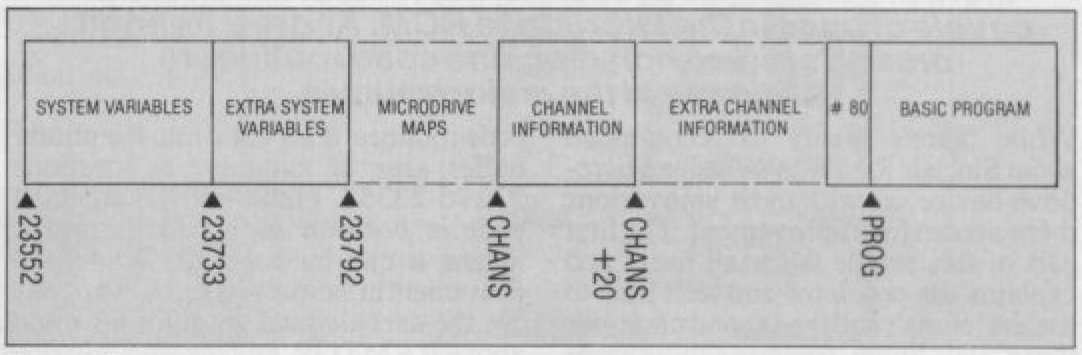


Figure 3. The area of the Spectrum memory map affected by the second of the three routines.

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THE ANT MAN COMETH

Overseeing the ins and outs of our competition this issue, **Sandy White** *found time to rap about the fame and fortune of being caught up on the front page of the software scene.*



IAN McKINNELL

Behind you!!! Sandy White gets a taste of his own medicine.

Every now and then, the software market blossoms and an incredibly different hybrid evolves. Always, just when you think it's safe to banter about the banality of the current software selection on the high street shelves, something new comes along heralded by the fanfare of enthusiastic reviews from all and sundry. Such a program was Quicksilva's *Ant Attack*. Or perhaps more in keeping with the recent trend towards the 'software superstar', one should say Sandy White's *Ant Attack*.

When asked about himself, Sandy modestly replied, "I'm hard to categorise really, but I do have a degree in sculpture." Indeed, Sandy is the first to admit surprise over the attention thrust upon him, for this time last year he was an unknown sculptor. After five years attendance at the Edinburgh College of Art, Sandy was happiest constructing electronic 'story-telling' gizmos which his lecturers were quick to tell him were not art!

A little disheartened at his progress in the art world, Sandy borrowed a friend's Acorn Atom to "fiddle about with a few graphics routines". After experimenting in Basic and machine code, he was about to give up . . . when inspiration struck. Excited by the computer graphics simulations in Walt Disney's movie *Tron*, Sandy set about using the routines he had created to emulate some of the features included in the big screen on to his monitor.

The knowledge to construct his soft-solid graphics certainly owed a lot to his college days. "I'd written big programs before, but *Ant Attack* was my first game — up until then all the software I'd written was linked to my work at college."

Not being a follower of arcade fashions, Sandy started to approach the game proper at a slow pace — having bashed out the code for the soft-solid graphics routines in an incredible two-week period, he needed ideas on how to implement the results of his labours as a popular game. So, after looking at a selection of 3D games already on the market, "I went to a lot of people I knew were keen on games software, and asked them about the ones they enjoyed the most."

It was at this stage that Sandy returned his friend's Atom and looked to the Spectrum's Z-80 to produce the miracles he had in mind. "The biggest problem with *Ant Attack* was making sure it was fast enough — some of the mathematical algorithms were really cumbersome. The game had to be fast enough to keep it reasonably exciting to play, while still maintaining the 3D aspects as well as could be allowed. Of course it's possible to do the most incredible 3D simulations on the Spectrum — as long as you're prepared to wait half an hour between moves!"

Indeed, it was 15 weeks of solid programming before Sandy was happy with the game. His close friend, Angela Sutherland, did a lot of the formatting of the structure for the final product; she was responsible for most of Antescher's design and also the characters who act out the adventure.

Completing the game was not, as one might suspect, the final hurdle in the game's development — for if Sandy knew little of the available games he had to compete with on the software market, he knew absolutely zilch about the methods by which an unknown could get software out on to the market. Where should he start? Difficult question . . . easy answer (or so he thought!).

"Yes, it's true, I first sent a copy of *Ant Attack* in action on video tape to Sinclair Research," laughs Sandy. "And after a couple of weeks, I gave them a bell as I was really keen to see the game published by Christmas '83. A secretary there said she was sorry but they hadn't got a video tape machine — so they sent it back . . . unseen!"

Following the brush-off from his self-confessed 'hero', Sandy was at a loss at what to do with his programming masterpiece. Psyching himself up, he placed a call to Quicksilva. "I phoned up Quicksilva," explained Sandy, "but I gathered fairly quickly that they've obviously got a lot of people phoning up and proclaiming that they've written the best game ever. The only thing to do was to go really over the top about the game and hope that they would listen. I ended up jumping up and down on the spot while explaining what I had done — and eventually they said they would have a look at my video tape. I was amazed at how difficult it was to get through to people —the only thing I can suggest to new programmers who think they've got something worth raving over is simply to rave about it yourself . . .and persist!"

Following Quicksilva's inspection of the video tape, Sandy was on a plane to Southampton the next day to sign a contract. And at 23, Sandy is in the enviable position of having his first foray into commercial games-writing heralded by most reviewers as the 'program of the year'.

Looking to the future, rest assured you've not heard the last of Sandy White. When *YS* spoke to him after the launch of *Ant Attack*, he happily chatted about his plans to write "a kind of adventure, not necessarily involving text — instead of entering a room and reading abut the contents and typing out what you want to do, how about actually interacting with the room's contents in real-time . . . " How about that indeed! However, on a recent trip to the *YS* offices, Sandy was coy about his plans for the future. Yes, they did include writing a new game, but no, he would rather not comment on the structure or design of the program. Could it be we're in for another classic . . . watch these pages for future developments. □

Turn to Page 52 for Your Spectrum's amazing Ant Attack competition!!

YOUR SPECTRUM ANT ATTACK COMPETITION

WIN OVER 1,000 SOFTWARE PACKAGES AND A DREAM SYSTEM TO RUN THEM ON!!!

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▶▶ PROF. BRAINSTAWN'S CREEPY CONTEST

Based around Quicksilva's chart-topping *Ant Attack*, have we got one son of a 'creepy crawly' competition for you this time around!

Anyone who's played the game can skip this bit — you won't need us to tell you about the fantastic graphics, etc, etc. But, for the uninitiated, here's a brief description of the action.

Enter the ancient walled city of Antescher, a mausoleum of architecture left to decay in the Great Desert. The ruins are inhabited by a rather rare species of ant (whose main diet seems to be human beings of the rescuing kind), and all you know is that your soulmate has been stashed away somewhere within the maze of buildings.

So, armed to the teeth with grenades, your task is to climb over the wall and battle with the ants in an attempt to foil your partner's kidnappers. But, once you've rescued one dumb friend, you find that yet another has managed to get lost in the maze; and so the rescuing continues, on through ten levels.

▶▶▶▶ READ CAREFULLY

As you move from level to level (assuming you don't get eaten alive), you'll find your soulmate can be located in any one of four 'random' sites in Antescher. Therefore, for part one of our competition, all you have to do is to locate the four possible sites on the *tenth* level. (Yes, that does mean you'll have to play the game to the tenth level at least four times!)

Just to get you off to a flying start in your quest, *Your Spectrum* is proud to present *YS* readers with a free colour poster depicting the entire architectural layout of Antescher. Designed by Sandy White and Angela Sutherland, this exclusive poster comes complete with all the author's own names for the locations of interest in the city.

As well as being an essential reference guide for anyone playing *Ant Attack*, you'll need the names of each location from the poster so that you can enter our Creepy Contest. Each time you discover one of the four rescuing sites on the tenth level, you'll have to locate the area on the Antescher poster and make a note of its name. Find all four locations and you're well on your way to winning Prof. Brainstawn's blockbuster prize.

Of course, this gives rather an advantage to those who already own a copy of *Ant Attack* and to whom the perils of the tenth level mean nothing. For this reason, there is a second part to the competition — one that will slow the frontrunners down for a while and allow newcomers to catch up.

The final part of our Creepy Contest will be found in the classified



ads section of either **The Guardian** or **Daily Telegraph** newpapers on *Friday, March 30, 1984*. Look for the headline, *Ant Attack — YS*, and you'll find all the information necessary for completing the competition, plus a phone number to ring us your answers. That telephone will be linked up to an automatic answering machine which will be ceremonially switched on at 12 noon on March 30.

The first caller to give us the four correctly-named locations of the missing persons on the tenth level of *Ant Attack*, and also the answer to the question given in the newspaper, will be declared the winner of the competition. Entrants must also give their name and address — otherwise we won't know who to send all the goodies to!

▶▶▶THIS IS WHAT YOU GET

Before you rush off to begin your errand of mercy, hang on a bit and find out what you could win.

You may have heard the name Prism rear its head recently over the launch of the world's first generation of personal robots. But the company's perhaps better known in the computing field for its Micronet 800 system, and more importantly as the UK's largest distributor of Spectrum (and other) software. And it's to Prism that *YS* extends its thanks for providing such a superb prize.

For the winner of our Creepy Contest will be taking away over 1000 (count 'em) packages of Spectrum software. That should be quite sufficient to keep someone quiet for the rest of 1984!

On top of that, the winner will also receive a complete Spectrum outfit, comprising a pristine 48K model Spectrum, ZX Printer, ZX Interface 1 and 2 units, and the much sought-after ZX Microdrive. To compliment this dream system, *YS* must also extend its thanks to Fuller, Kempston, Currah, RP Products, East London Robotics and Basicare, for providing a professional keyboard, a Centronics printer interface, a MicroSpeech unit, a Sureshot joystick, a Trickstick, and a complete range of Basicare add-ons, respectively. Truly, a treasure trove of delights! And what's more, our lucky person will be invited to the splendid offices of *Your Spectrum* to receive the gear (what a treat — Ed.).

But there's still more. For the next three correct answers given over the phone, each will receive £100 worth of Spectrum software. And after that, the next 25 correctly-answered phone entries will be given a year's supply of *Your Spectrum* completely free. So, don't hesitate to call — there's a good chance it'll be your lucky day!

So, that's it! Up with the poster, on with the Specy, boot up *Ant Attack* and get searching for those missing persons.☐

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Obviously we haven't got room to list all of the software we're giving away for the first prize — but to whet your appetite, take a look at this lot:

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On the face of it, the software market oozes sweetness and light — but it's the warts and boils that often prove more interesting.* Ron Smith *takes a behind-the-scenes look at the power struggles.

RUMBLES

Hollywood, once famous for its moguls and *prima donna* stars, has long since gone into a glittering decline. But nowadays, there's another world of fantasy ready to take its place — the world of microcomputer software production. Young programmers can, and often do, become overnight successes by writing a bestseller, while the software houses that market the goods can make veritable fortunes and their owners become Havana-smoking tax exiles with even more indecent taste than many a moviemaking predecessor. And that, in short, is just what this page is all about: the people, the companies and the products that go to make up the popular software business.

MANIC MATTHEW JOINS THE JET SET

One of the biggest shocks to reverberate through the industry of late has been Matthew Smith's decision to sever his connections with Bug-Byte, one of this country's largest software houses. Matthew, author of the best selling *Manic Miner* game for the 48K Spectrum, agrees that "Bug-Byte had the contract to both produce and market" this popular game, but that in his opinion "their marketing techniques were not all they should have been".

Matthew has therefore decided to quit his contract with Bug-Byte and move over to Software Projects — a company including himself and Bug-Byte ex-employee, Alan Maton. All, however, may not be well within the portals of SP, for the embryo company's new game *Jet Set Willy*, which has been promised for some time now, "is still not completely written", claims Matthew. But he urges, "it won't be long now", and promises that *Your Spectrum* will be one of the first to see a pre-production copy as soon as one can be cobbled together. Watch these pages for further developments on that one.

What does seem a little strange, though, is that if Bug-Byte had its ace programmer under contract, how then has he managed to break himself free so easily? The answer is now clear. Matthew Smith had made his decision to move on, and according to Bug-Byte's Tony Baden, "*Manic Miner* had passed its peak, and we really didn't feel like taking a 17 year old to court". Under the circumstances, it obviously seemed better to just let Matthew and his program go.

So, what about Bug-Byte's future? Tony Baden reveals he has registered *Manic Miner*, and intends launching a new improved version for the Commodore 64 in the near future. However, once bitten, twice shy, etc, etc, and Tony adds that after the experience with Matthew, "We're definitely put off using people under 18 in the future". Perhaps there's a lesson there for you would-be micro geniuses.

TROUBLE 'T MILL

Still on the subject of wayward programmers, Carnell Software too has had one or two problems of late. It all started with what was intended to be a series of programs known as *Starforce 1, 2, 3,* etc. A programmer was put to work, but instead of coming up with the expected supersmooth arcade game where the players find themselves at the edge of a maze with the unlikely task of getting to the centre in order to destroy the computer, what was actually produced was something a lot less than perfect. Indeed, so much so that Roy Carnell and fellow director, Stuart Galloway, felt moved to "give him a right **!!**ing for writing such a *??!!* program, then throw him off the project". But commercial pressures cannot be ignored and Carnell, after a quick rethink, decided to reinstate his fallen genius, giving him just two days to improve the product. This we're told he managed to do, although just how welcome his stay will be as a result of all this is open to speculation. Gee, it's tough at the top!

Carnell Software is also currently working on two new programs, one adventure and one arcade. The adventure, a sequel to *Volcanic Dungeon*, will consist of three programs and these will come supplied with a 200-page book (giving the history of the Third Continent, a guide to the monsters and over 100 handy spells to help players overcome various hazards). The arcade game, *BobaJob*, will be the only one of its type, requiring two programs to play the game. Apparently, it features a boy scout who has various jobs to do for a number of grannies. Expect these on your high street shelves soon. . .

BLACK BISHOP ZAPS RED QUEEN

If the idea is anything to go by, then it's probable that Artic Computing will score with its latest project — based around the ancient game of chess. Ho humm, you may say, but this is not just another old chess game.

Artic's spokesperson, Chris Clark, reports that, "It's to be called *Death Chess 2000* and will include all the fun of the board game, with plenty of highly entertaining arcade action". All of which sounds a little strange, but nevertheless, rather interesting. Let's hope it doesn't turn out to be a case of protecting your king from the invading lesser pieces. Once complete, claims Chris, "the game will include eight or nine levels of arcade fun". Chris also drew our attention to their new widely-advertised (but not yet available) *Bear Bovver* game. Check out the screen photograph for a glimpse of what's to come.

Board games are a popular source of inspiration for program writers at the moment, and A&F Software has recently signed the rights to a new title, launched recently at the Earls Court toy fair. Computerisation is under way and it'll be interesting to see which achieves the better sales — the program or the original board game. Cagey Mike Fitzgerald, having said this much (and avoiding the temptation of giving anything else away), then went on to talk about A&F's move to new offices in Greater Manchester. He says they are "bigger, nicer and unfortunately more expensive." And being based in Rochdale, he firmly denies industry rumours by saying, "There's absolutely no truth in the rumour that we're being called the Rochdale cowboys — *pardner*!".

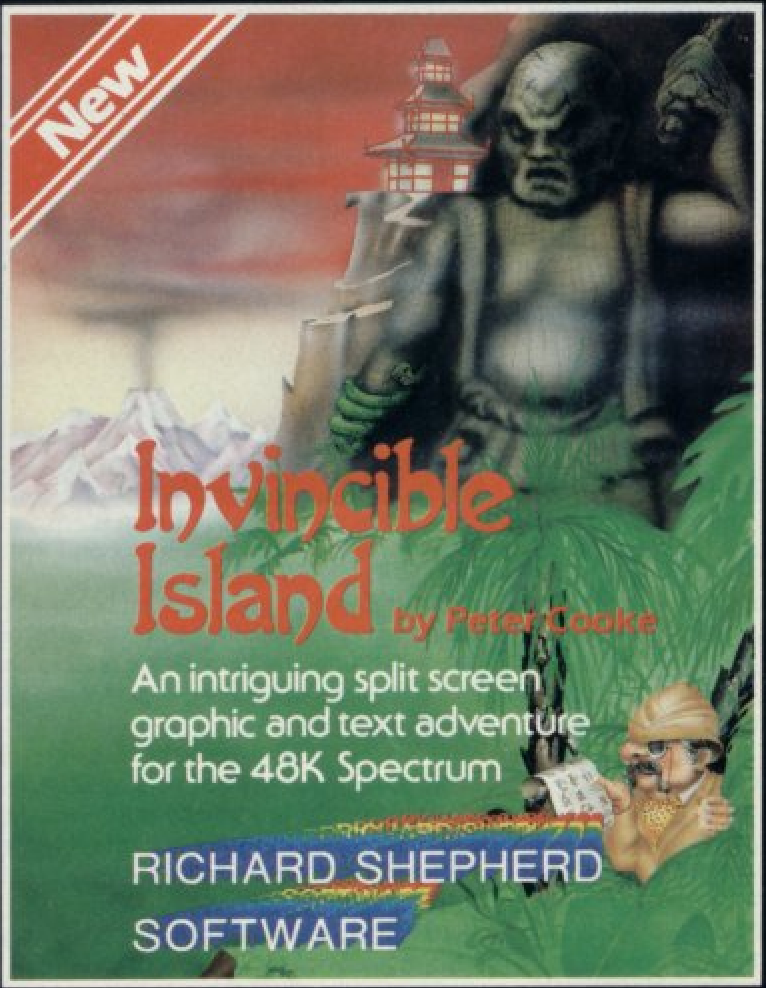


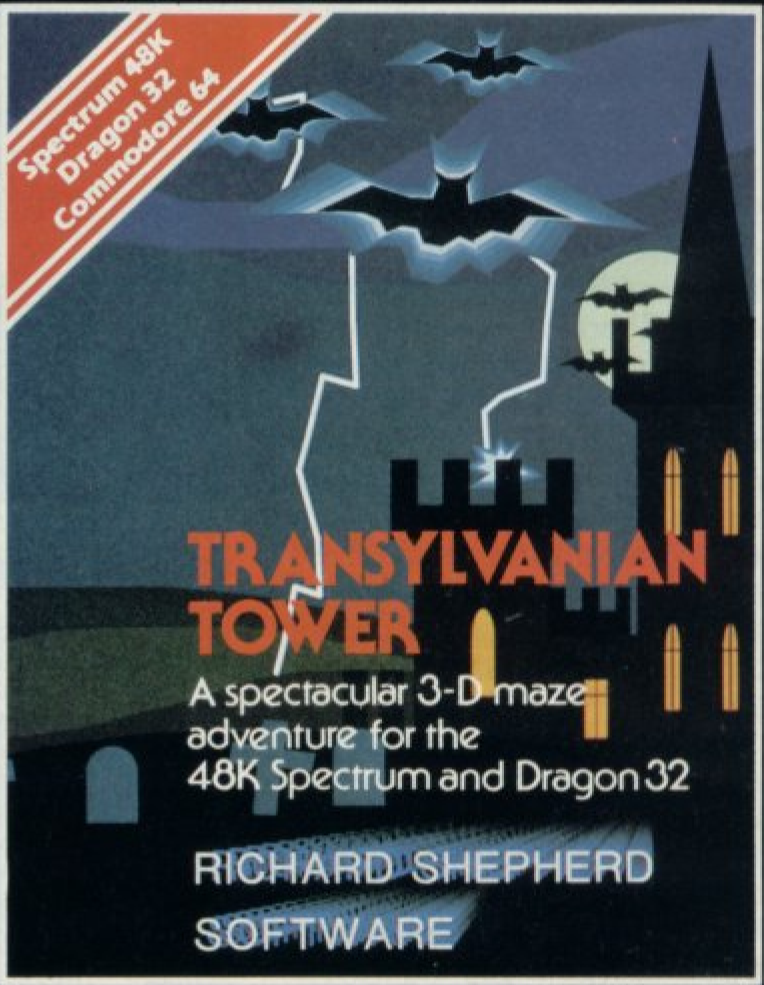
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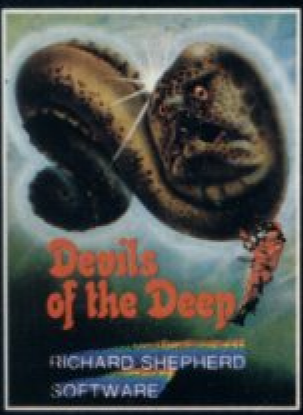
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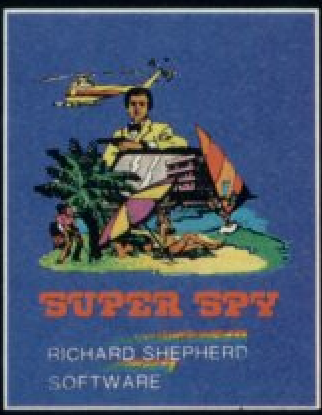
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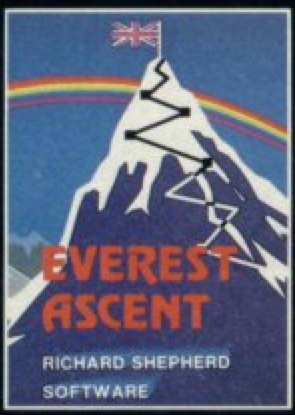
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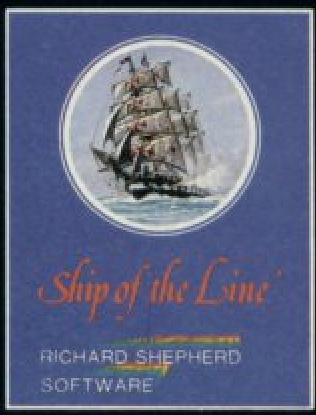
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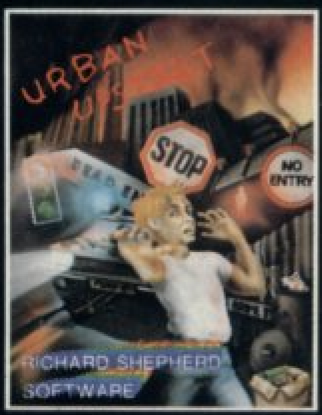
"ADVENTURES INTO IMAGINATION"











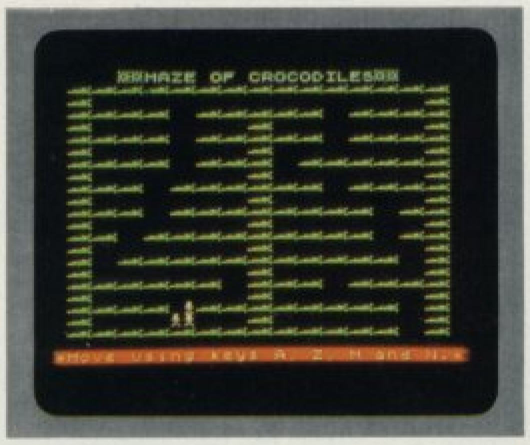
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SPECTRUM SOFT

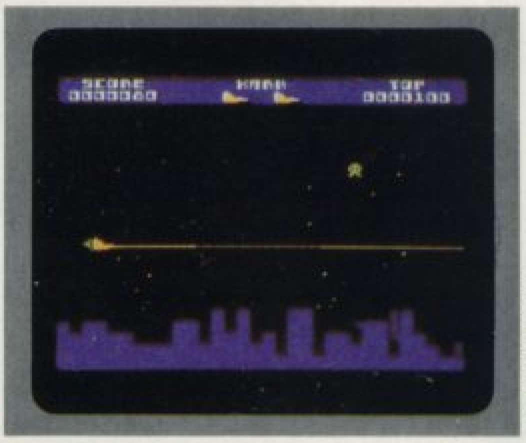
Starting this issue* Your Spectrum *will be touring computer clubs up and down the country in an effort to find dedicated games enthusiasts who will give us their impressions, thoughts and feelings on the current selection of new releases. Little do they know it, but these unsuspecting souls will be contributing a large slice of our regular review section in the future.

This month we visited the Stanwell Computer Club (which meets weekly at the Stanwell School, Short Lane, every Friday evening from 7-10pm). Five of the resident 'freaks' were enlisted to tell us (and you) what was good or bad about the programs we gave them to play around with. In some cases comment was justifiably harsh, and in others they could hardly contain their glee at coming across a really well thought-out game.

The guinea-pig five whose comments appear below, are all members of the club, and they are (in alphabetical order): Corrie Brown, Stephen Cathrall, Ryan Davis, Stewart McPherson and Peter Shaw. Peter, by the way, is also Secretary of the Stanwell Club. Them we do thank.



SPECTRUM SAFARI
CDS MICROSYSTEMS/£5.95
A semi-adventure where you wander round the screen coming across various animals which all ask you to play games, or solve riddles. Really, a sort of compendium of games rolled into one.
Peter This is a collection of bad 'magazine type' programs thrown together, with less than spectacular graphics and an average choice of colours. And because it's written in Basic, it's not particularly fast.
Stewart There's an overall strategy theme, with varying speeds for each section — although it's never dazzlingly fast. You'll find such items as gorilla-gambling, snake-shooting and guessing games.
Stephen This is a sort of adventure, but the player need not be too skilful at arcade games to succeed.

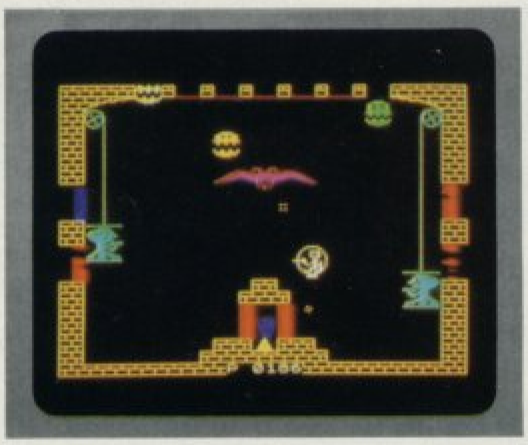


IAN McKINNELL

XARK
CONTRAST SOFTWARE/£5.95
A *Defender*-type game in which you are (according to the classic game theme) the last survivor of the planetwide attack, and as the last one left, it is up to you to save the rest of the planet.
Peter Speed, colour and graphics are all just above average, but perhaps the graphics could have been a little better considering this is a 48K game. Overall, a poorly presented *Defender* conversion.
Stewart It's quite fast, but slows down considerably if the player fires continuously. And there's little variation between the four screens, which makes it boring in a matter of minutes.
Ryan Could become a best seller! Only one complaint — and that's the choice of keys.



ROBBER
VIRGIN GAMES/£5.95
An original idea that involves you in stealing the loot, and avoiding the searchlight as it scans the screen.
Peter Although this program was put together using the Softek compiler, it's still awfully slow and the graphics have taken a backward leap in time to the simple block graphics of the ZX81. It did seem that Virgin Games were improving their software selection . . .
Stewart Unbelievably slow, this game is a long way behind the times graphically, and generally leaves a lot to be desired.
Corrie Basically, very slow. Not bad overall and an original idea but frankly, a rotten presentation.



DOOMSDAY CASTLE
FANTASY SOFTWARE/£6.50
A graphics adventure in the true sense of the word. You control a little man who zooms around the castle, collecting various objects, etc. It's similar in style to *Atic Atac*.
Stewart The nasties are nicely designed, and their movement is delightfully smooth. Constant attention is demanded by the 'Urks' and 'Carthrogs' as they rush around the screen.
Peter Here is a very colourful arcade game with an adventure-type aim. Very enjoyable and well worth a look.
Stephen Quite a slow response to the player's directions, even when using a joystick. Otherwise, I liked it.



PAT THE POSTMAN
MIKRO-GEN/£6-95
The concept of this game is simple; all the player has to do is to help Pat — the amnesiac postman — collect parcels from various houses and take them to the Post Office.
Peter Good colour, bad graphics and *very* slow. But the worst part about this game is the lack of instructions, which makes it a bit difficult to find out what's going on.
Stewart Simple block graphics and average use of colour are the extent of this game's presentation.
Ryan Definitely not one of Mikro-Gen's best efforts. There are much better games around for the money.



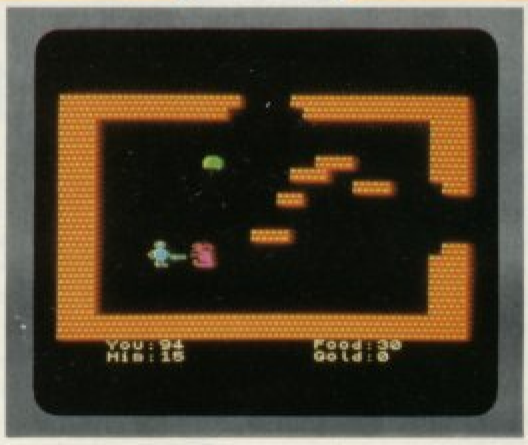
URBAN UPSTART
RICHARD SHEPHERD SOFTWARE/£6.50

A truly graphic adventure, with a picture for each location you wish to visit. You are wandering around Scarborough and, like everyone else, your main aim in life is to escape!

Corrie The graphics are quite exceptional in this program, and there's no fuzziness where the colours meet. Definitely a good adventure, and one that I highly recommend.

Stewart Graphic representation of each location can be found in this program, and these vary from simple line drawings to some quite detailed scenes. Generally I prefer to see adventures use up memory for ideas rather than pictures, but at least the program does it competently.

Peter The response time is not as fast as it could be, but the use of colour and graphics are very good. An extremely entertaining game.



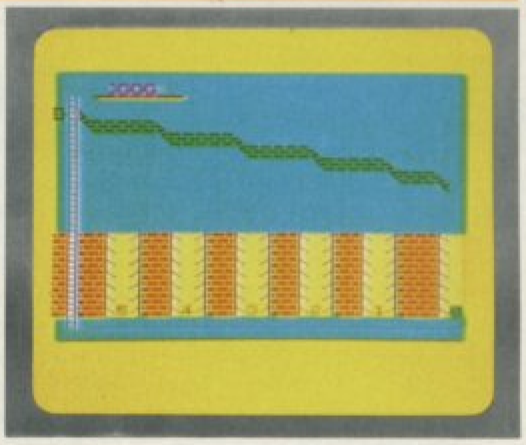
THE CRYPT
CARNELL SOFTWARE/£4.95

A very graphical adventure, in the same style of *Atic Atac* (in that you look down upon the action from above). You can choose your weapons, etc, by picking them up off the floor of the crypt. An extremely complex game, with graphics and text.

Peter The graphics are used imaginatively throughout this game, and the response time isn't bad. Overall, it's a very nice graphical adventure.

Stewart The speed of this game is adequate, given that it is essentially an adventure game. I would describe the use of colour and graphics as average. A complex adventure, but I found ways of cheating quite easily.

Stephen You can select which level you wish to play and, at the end, the game refuses to tell you the secret of the Crypt!



BARREL DROP
GAMES MACHINE/£5.95

You have to catch barrels as they drop from the top of the screen, aided only by your dog. Your name is Flash and the dog's name is Gordon — shouldn't it be the other way round?

Peter Written in Basic, this game is slow, the graphics are unexciting and the colour is bad. It's a very tedious game and the riddles between rounds only seem to increase the tedium.

Corrie I've seen better 16K games designed to run on old tin boxes! Well, not really — but this isn't too good.

Stewart Having achieved success in the first game, the player must answer a riddle or get through a mini-arcade game in order to move on to the next round. But subsequent rounds don't vary, even in speed, and riddles are often repeated, even when answered correctly first time round.



McKENSIE
SOFTWARE PROJECTS/£5.95

This is a text adventure based on the world famous explorer Captain Vito who, while on a scrounging mission for lithium crystals to fuel his spacecraft, has managed to be captured by space bandits. He has just one hour to escape before the air supply runs out.

Peter Response time is average, which is just as well because there's a limit of one hour set on the game. It would have been more enjoyable had a little more humour been introduced.

Stewart Location descriptions are brief to the point of being terse, and the accepted commands are very specific, with not many clues supplied. Funny, but the player takes the part of Captain Vito — so who on earth is McKensie?

Corrie If you like adventures, but you are just a beginner, I would suggest you try something a bit easier.



MR WIMPY
OCEAN SOFTWARE/£5.90

This is a version of the arcade game *Burger Time*, and you take the place of a chef desperately trying to find the ingredients required to make a beefburger. Numerous attempts are made to stop you fulfilling your cooking quest.

Stewart Starts off slowly, but soon speeds up to an acceptable level. The graphics are a treat, and the burgers are actually burger-coloured, adding that extra touch of realism. A very nice game in all, but arcade games need to be better than brilliant nowadays.

Ryan Very addictive, and lots of fun. Definitely worth the money.

Peter After playing the game for some time, three short descriptions sprang to mind — very good, excellent, and b****y marvellous. Building burgers is great fun!



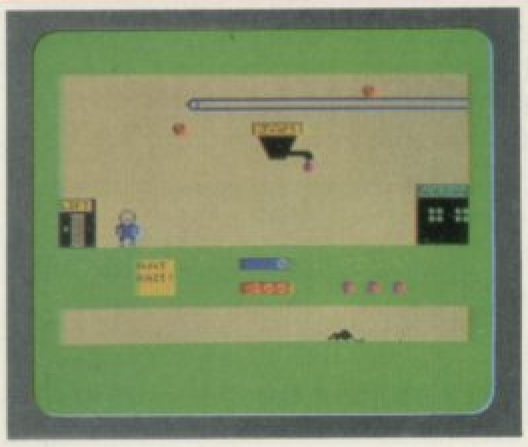
IT'S ONLY ROCK N'ROLL— TOMB OF DRACULA
K-TEL/£6.95

The first of this pair is a strategy game where you take charge of a rock'n'roll band and try to take them to the top of the heap. *Tomb of Dracula* is a graphics adventure set in a 3D maze.

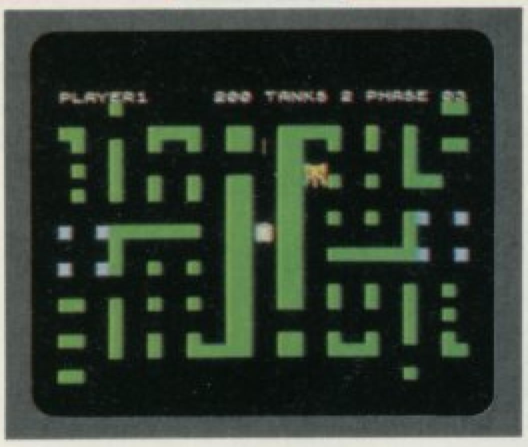
Stewart *It's Only Rock'n'Roll* is a text-based strategy game. I like the excerpts of the concert or the tour, but it's a shame about the music (I don't think they're going to make it to the top twenty!). *Tomb of Dracula* is an unexciting game, with too many obstacles.

Peter Both programs use colour quite well in places but completely neglect this aspect in others.

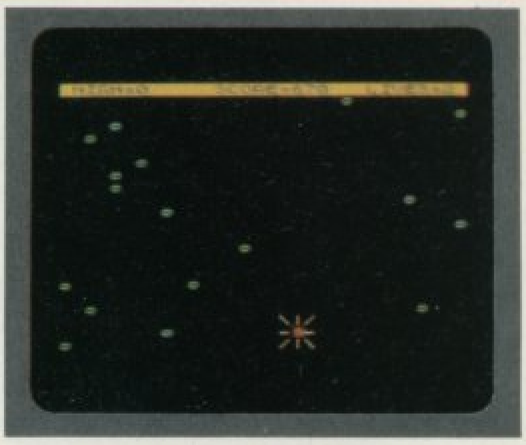
Corrie Both games on this tape are quite acceptable, but they're not as good as they could be. *It's Only Rock'n'Roll* is by far the best.



APPLE JAM
DK'TRONICS/£5.95
An original arcade game in which you have to eat as much jam and apples as you can without getting into trouble with wandering rats and bees.
Peter Most of the displays are pretty impressive and colourful, but that's not to say they couldn't have been improved upon. Overall, pretty good.
Stewart Particularly impressive are the man and rats, who grow in size the more apple and jam they eat. For a 16K program, this package contains an amusingly different theme and has some great features. For instance, lift journeys can be quite fun, especially if you judge its descent so that you squash a rat!
Stephen Play starts off very slowly, and gradually increases as progress is made. I would have liked it a bit better if the initial speed of the game had been set a little faster. That said, the game makes good use of colour and sound, and is certainly original.



BRAIN DAMAGE
SILVERSOFT/£5.95
This is an arcade game set in a maze, in which the idea is to shoot your opponent before you are yourself get blasted. Your opponents are the Electron Panzers, the Centurion and the Marauder.
Stewart Yet another maze game, this time with you in a tank that's being pursued by baddies who must be shot. Unfortunately, they shoot back — usually, and perhaps a little unfairly, with greater effect. Graphics are unexciting and use of colour average, but it does get progressively faster.
Peter Another arcade game that's similar to the 'Tanks' level of *Tron*, and one which I'm afraid got a little boring after 15 minutes or so.
Corrie Excellent, and with very professional graphics. I especially like the gun turret which can be turned to fire in any direction. *Brain Damage* is an excellent game with brilliant graphics and good sound.



ALIEN SWOOP-DOMAIN
SPACE AGE SOFTWARE/£5.95
Alien Swoop is a *Galaxians*-type game where you must shoot the aliens in their ranks, and also the ones that peel off and swoop down towards you. *Domain* is a version of the old chestnut, *Kingdoms*. You take the place of a country's king, and try to run the surrounding realm successfully.
Peter The use of graphics in *Alien Swoop* is very poor, while in *Domain* they're not too bad. Speed and use of colour, however, leave a lot to be desired in both games.
Stewart *Alien Swoop* is an extremely poor *Galaxian* simulation which is painfully boring. *Domain*, on the other hand, is a little better. It's a classic strategy game where you must rule a Norfolk village for 10 years, guarding against floods, brigands and starvation.
Ryan It's nice to see one arcade and one strategy game on the same tape, but there's plenty of room for improvement in both of them.



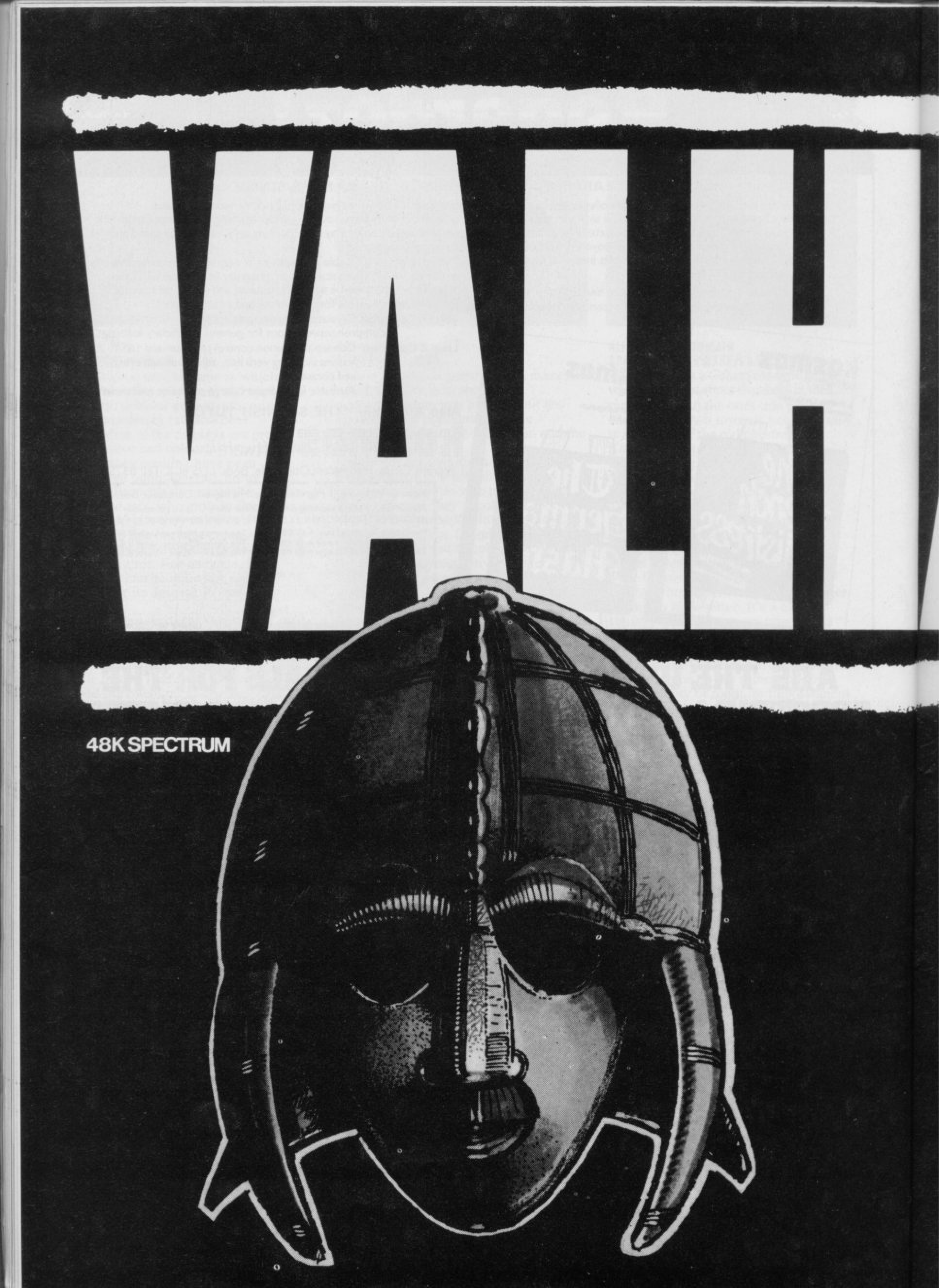
APOCALYPSE
RED SHIFT/£9.95
A strategic wargame, based upon an original board game under licence. The plot centres around four opponents attempting world domination.
Stewart A cross between a computer-assisted wargame and a sort of graphical strategy that uses block graphics. The game requires at least two players and could, in theory, last for years! I'd say it has only limited appeal.
Peter Very colourful, with cleverly-used block graphics, although it would have been nice to have seen more detailed pictures thrown in for good measure.
Stephen Unimpressive graphics, with the use of colour reaching the same mediocre standards.



SPECIAL AGENT
HEINEMAN-FIVE WAYS/£9.00
This is an educational adventure where players travel around Europe gathering clues and information. Its main aim is to teach geography to the 8-12 year old age group.
Peter There's a hi-res map of Europe which is very good, with the other displays also being very well laid out. It's professional and well presented.
Stewart There's a good map of Europe, and the various tables are clearly laid out — which all helps to make this a highly professional package in both presentation and program content.
Ryan The speed of the game is rather slow, but this is only to be expected in an educational adventure.



PAINT BOX
PRINT 'N' PLOTTER PRODUCTS/£7.50
Paintbox is a graphics utility which enables the user to create user-defined graphics and SCREEN$, allowing hi-res sketching with your UDGs.
Peter The presentation of this program is very good, and the demonstration pictures are excellent. It's very quick to respond, and one of the most outstanding programs I've seen this year.
Stewart A very impressive graphics utility program which enables quite stunning hi-res pictures to be drawn, saved and used within your own programs.
Stephen The demonstration contains the best graphics I've ever seen on the Spectrum. To be recommended.☐


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GETTING INTO PRINT

Good as it is for the price, many users are bound to be disappointed with the output from Sinclair Research's own printing device. For those toying with the idea of upgrading their Spectrum system with a professional printer,* Henry Budgett *takes an in-depth look at the technology involved and the plethora of interface devices now available.

Regardless of what one actually thinks about Sinclair Research's ZX Printer, it's impossible to ignore the fact that it really does work. For the price and performance that it offers there's no equal anywhere. But despite that, there are users who need something a little more professional. Software houses developing programs, small businesses using the ZX Spectrum or just a serious user who demands something better than a sheet of aluminised paper that is, at best, just legible after a few days' handling.

We're fortunate in having a number of commercially available interface units that allow the ZX Spectrum to be connected to the growing range of low-cost printers. In the main, these units convert the signals provided on the expansion connector into those which conform to the industry standard Centronics interface. There are two stages to this conversion: that of altering the electrical characteristics of the output from the ZX Spectrum and that of converting the character codes from Sinclair Research's own internal format to true ASCII.

The alterations to the electrical signals are handled in a variety of ways by the interfaces reviewed here; some use very sophisticated chips to handle the work, others tackle the task by using more of the simple ICs. Only one of the interfaces in this review offered the possibility of connecting to a serial printer but, in theory at least, the problems involved are tackled in much the same way.

All the interfaces were supplied with software drivers of one sort or another (see the individual panels for further details) and in general, these all work by intercepting the ZX Spectrum's printer routine vector. This is the location in memory that stores the address of the routine which controls data being sent to the printer by LLIST and LPRINT. By changing this address to that of the new driver all the data is re-routed through one of the OUT ports to the interface. On their way, each of the characters passes through a 'code converting' routine held somewhere in memory. While the normal alphanumeric codes closely follow the standard ASCII set, all the control codes, pre-defined graphics and Basic tokens must be intercepted. In the case of the tokens, these are converted back into strings of ASCII letters before being listed. Because many of the currently available printers use sequences of control codes to change character fonts or to select graphics, provision must also be made to allow these codes to be sent without being trapped.

The test equipment to which the various interfaces were connected comprised a Tandy CGP-115 four-pen plotter printer and an Epson FX-80 dot matrix printer. Unfortunately, the Epson turned out to be 'Dead on Arrival' and the author's Apple Dot Matrix Printer was substituted. As this printer is based on a TEC chassis, it proved impossible to check the graphics dump facilities on all but one of the interfaces. However, there is no evidence to suggest that the software provided wouldn't operate correctly with the appropriate hardware and indeed, the Kempston interface unit has been seen elsewhere to function perfectly with both the RX-80 and FX-80 printers.

Kempston Centronics Interface



IAN McKINNELL

Hardware: A very neat and specially designed casing houses the single printed circuit board. Featuring just two ICs (an 8255 and 4071) the unit is constructed from high quality components and mounts vertically behind the ZX Spectrum, contact being made through a gold-plated edge connector. No provision has been made for other units to cascade from the rear of the interface. The interface cable is detachable but not keyed at the interface end; it might therefore be possible to connect it upside down.

Manual: The accompanying documentation consists of just four pages, A5 sized. All the necessary


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GETTING INTO PRINT

information to attach and operate the unit is given although the quality of the photocopy is poor in places.

Software: Four programs are provided on cassette to support the interface and all reside in the printer buffer when loaded. The main program is a simple text-only driver which supports LLIST, LPRINT, PRINT AT, TAB AND ','. All the standard ASCII characters are coped with and all keywords are de-tokenised; control codes can be sent by LPRINTing the appropriate CHR$(x). In addition to these standard features the software supports a TEXT COPY, called by RANDOMIZE USR 23370, and allows the number of characters per line to be set. Also included, and very useful too, is the facility to enable or disable the Line Feed character after each Carriage Return.

Kempston also provides, on the same tape, three high resolution copy programs. These effectively replace the text driver's TEXT COPY with a screen graphics copy, all other facilities remaining the same. The first program is for all the standard Epson printers, but programs for the Seikosha GP80/GP100 and the Seikosha GP250X are also provided.

Price: £45.00 all inclusive.

Summary: An excellent product and one which, in a commercial software environment, has proved to be totally reliable. The instructions are short and sweet, no problems would be encountered by even the newest of newcomers.

Euroelectronics ZX LPRINT MkII



Hardware: This unit was the only horizontally fitted interface of the range under review. A single PCB is sandwiched inside a small, standard 'plotting' box; the result is not particularly attractive. A detachable ribbon cable, just over one metre in length, plugs on to the rear of the unit and although no key is provided at the unit end, it would be difficult to plug it in the wrong way around. On the review sample, the plastic frame of the PCB-mounted header had been cracked but no problems resulted.

Interestingly, this interface does the COPY processing internally — a ROM contains suitable software for the printer chosen. Of the six remaining ICs, two had had their idents removed and as they all appear to be common devices, the reason may be that they are rejects — which could bode ill for long-term reliability.

Manual: It seems almost churlish to call a single side of A5 paper a manual! However, further information is provided 'on-screen' once the software is loaded. Interestingly, there is no mention of LLIST anywhere, yet it works!

Software: The driver consists of a short (109 byte) routine that forces itself to the top of memory and then resets RAMTOP. All the rest of the processing is carried out by the ROM in the interface. To prove that it really works, the tape includes a demo picture to dump — one of those highly magnified views of a pimple! The COPY program supplied with the review sample was suitable for driving the Epson range as well as the Star DP510 and 515 printers and the Shinwa CP80.

Alternative software is available for the Seikosha GP100 and GP250X printers, the Microline series and the latest offering is for the Tandy CGP-115 and MCP40 printer plotters which can provide (very slowly) copies in four colours. A new version of the interface is due out shortly with a range of software built in as standard.

Price: £34.50 plus £10.45 for the cable.

Summary: Despite its rather shabby looks, the LPRINT worked well and the provision of software in ROM makes for faster operation. When your author passed comment on its appearance to a friend he replied that he expected interfaces to look like that! The price of the cable is very high and it might be worth making your own. But apart from that it offers good value for money.

Morex Peripherals Centronics/RS232 Interface

Hardware: The vertically mounted box is functional rather than attractive, and the cut-out appears at first sight to have been made by a hungry rabbit! Even more important than mere aesthetic quality is the fact that the casing partially covers the power socket on the ZX Spectrum; also, the plug has to be forced in and is very prone to dropping out again. As far as design goes, this doesn't. However, the unit was also the only one in the survey to allow other units to be attached in cascade — although the way in which the edge connector is soldered leaves a little to be desired.

Inside, however, the circuitry consists of just four ICs, which is a very compact design considering the inclusion of the serial interface. Both parallel and serial cables are detachable; the parallel cable is keyed but because it's BBC Micro compatible it appears to go in the wrong way. The serial interface socket, a conventional DIN type, is not very firmly anchored to the PCB and heavy use could fracture tracks.

The serial interface is not a full RS232 implementation, although 'handshaking' is provided. While it will suffice to handle printers or display terminals, it's possible that problems may occur with more sophisticated equipment such as modems. The interface performed perfectly with the CGP-115 in serial mode.

Manual: No less than 15 A5 pages accompany this interface. Just about everything is provided: pin-outs of all



the connectors, routine addresses within software and hints on getting problematical equipment moving. Also supplied are a couple of example screen prints and a copy of Tasword, probably the most popular ZX Spectrum wordprocessing package.

Software: As provided, the driving software is configured to produce screen copies on the NEC range of printers; however, a simple POKE will set it up for the Epsons. The LLIST and LPRINT commands work with any of the common devices. Morex also provides the information on enabling or disabling token printing and automatic Line Feeds.

The serial interface can be configured in much the same way with a wide range of baud rates being catered for. Once the software has been adapted the altered program can be SAVEd as a permanent copy.

The screen copy software allows both 'single-size' and 'double-size' copies of the screen to be made; the latter are really very impressive.

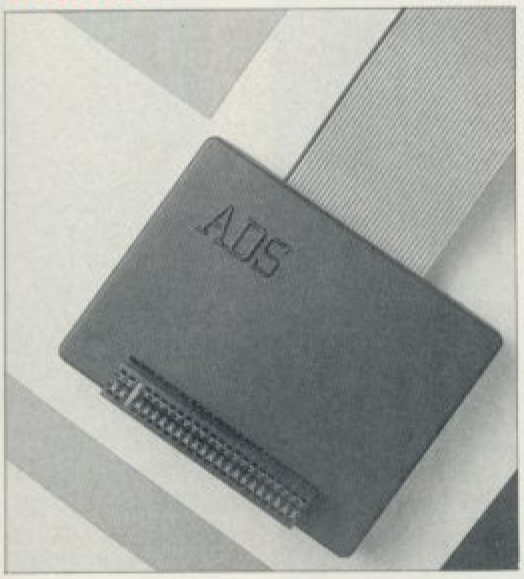
Price: £48.60 including one cable. £13.40 for second cable. £4.80 for alternative software.

Summary: Despite its ragged appearance, the Morex unit offers the

GETTING INTO PRINT

user both serial and parallel interfaces at a very attractive price. It's also the only unit to offer a really thorough manual and, given that you need both types of connection, this interface rates very highly indeed.

ADS Centronics Interface



Hardware: A slim, vertical mounting unit housed in a custom-made casing. Even neater to look at than the Kempston, the interface is excellently constructed internally. The attention to detail is very high; the power supply to each of the seven ICs is filtered by its own capacitor, but on the sample submitted some of the soldering left a little to be desired. The interface lead is some 1.5 metres long and not detachable from the interface. Also, no provision has been made for other interfaces to cascade from the rear of the unit.

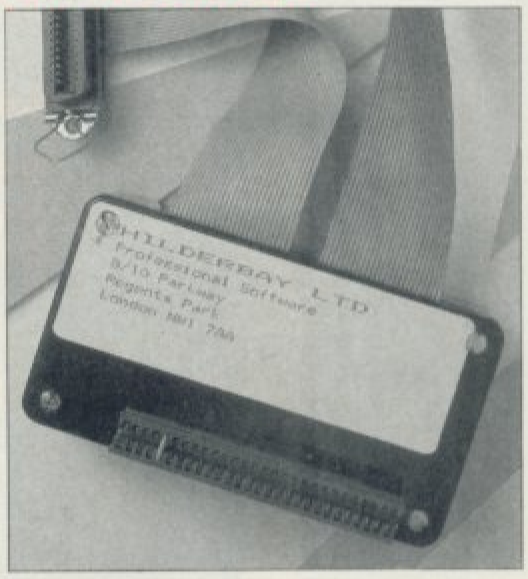
Manual: Four A4 pages of matrix quality printout provide a substantial amount of detail, although some of it needs reading two or three times. It gives a full explanation of where the software is located and hints are provided on how to alter the COPY routine to suit printers other than Seikoshas.

Software: Two routines are provided on tape: one to do simple text listings and the other to give high resolution screen dumps on to a Seikosha GP250X printer. The text printing routine allows the token expansion to be suppressed in order to send control codes. As the software is fully relocatable, it's possible to fit it anywhere, though normally it loads into memory and then relocates to the top before setting RAMTOP to protect itself. ADS is currently working on an upgraded version of the high resolution dump software to give full colour screen images through the Seikosha GP700A printer.

Price: £34.50, all inclusive.

Summary: A superb unit, equal in many ways to the Kempston, but slightly let down by the provision of supporting high resolution dump software for only one range of printers.

Hilderbay Professional Printer Interface



Hardware: Housed in the same kind of box as the Morex interface, this vertically mounted unit also suffers from the aesthetic point of view. However, it more than makes up for that by the features it includes. Equipped with two Centronics leads, one short and the other a generous 1.5 metres, it also acts as a printer spooler.

The internal design is messy and the attention to detail during construction looks poor; at least two of the internal straps were in danger of shorting out to IC legs. The chip count is small: an 8255, a 4071 and an unidentified device are all that reside on the PCB. A 3.5mm socket is also provided on the unit; this intercepts the EAR lead to the ZX Spectrum and does away with the hassle of having to remember to unplug it each time you do a SAVE.

Manual: Seven A4 pages cover everything about the interface, including the various graphics dump routines (although quite who would have the patience to wait while a Juki daisywheel printer does a screen dump is beyond me!).

Software: The review sample came with a full driver which resides in normal memory and a smaller mini-driver which lives in the printer buffer. The penalty paid for using the smaller verion is that all the control codes are trapped, so specific POKEs must be issued to get the printer to operate in other fonts or modes.

A second tape, together with two sheets of documentation, covered the use of the interface as a spooler. Here

Y.S. HARDWARE REVIEW PRINTER INTERFACE SUMMARY

	KEMPSTON	ADS	LPRINT	MOREX	HILDERBAY
FACILITIES					
Parallel (Centronics)	●	●	●	●	●
Serial (RS232)				●	
Extender				●	
Vertical mount	●	●		●	●
Horizontal mount			●		
Detachable lead	●		●	●	
LLIST	●	●	●	●	●
LPRINT	●	●	●	●	●
Programmable CR/LF	●			●	●
Spoole facility					●
Microdrive compatible	●	●	●	●	●
GRAPHICS DUMP SOFTWARE					
Epson RX/FX series	●		●	●	LISTING
Star DP 510/515	●		●	●	
Shinwa	●		●	●	
Seikosha GP80/GP100	●		AVAILABLE		LISTING
Seikosha GP250X	●	●	AVAILABLE		
Seikosha GP700A		AVAILABLE SOON			
NEC				●	
Tandy CGP115/MCP40			AVAILABLE		LISTING
Juki daisywheel					LISTING
Microline 80			AVAILABLE		


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GETTING INTO PRINT

the ZX Spectrum is used as a printer buffer for a larger computer. When conventional microcomputers are dumping text files on to a printer, the machine cannot do anything else; in fact, while this review is being printed out by my Apple IIe, there really is time to make a cup of coffee. What's needed is a large memory store into which the entire contents of the text file can be loaded. Control of the computer is then restored to the user while the text is being fed to the printer from this buffer. The ZX Spectrum offers a fairly low cost alternative, by using it in conjunction with the Hilderbay interface.

The printer spooler idea can be taken even further by allowing the ZX Spectrum to perform some post processing on the text that it's storing. One such program is being developed to allow true justification with proportionally spaced text. Developed for Diablo-type daisywheel printers, it unfortunately doesn't allow buffering at the same time . . . still, you can't have everything.

Price: £99.00 all inclusive.

Summary: For reasons known entirely to itself, the Hilderbay unit declined to operate as a spooler with an Apple DMP, although its performance as a standard interface was flawless. As the great strength of the professional unit is that it can operate as a spooler, this was a little disappointing.

While the interface as it stands is as good as any of the others, it's the possibility of using it as a buffer that makes it stand out from the crowd. If you already own a bigger computer and just use the ZX Spectrum for games or for children to learn on, then this interface offers both real printing on the ZX Spectrum and time saving for your bigger machine.

Overall Summary

Of the three standard units — Kempston, ADS and LPRINT Mk II — the latter inherently has the advantage of on-board software, giving it greater speed and more flexibility. Between the other two the ADS is slightly the neater but the Kempston is supplied with a better range of driver software and virtually everything works with it directly.

The two 'up-market' units both have advantages in their own ways. For serial printers there is no option but to choose the Morex unit. It offers parallel as well and comes complete with an excellent manual; if pushed, it probably represents the 'Best Buy'. It's a shame about the packaging – fit a nice box around it and you'd have a real winner.

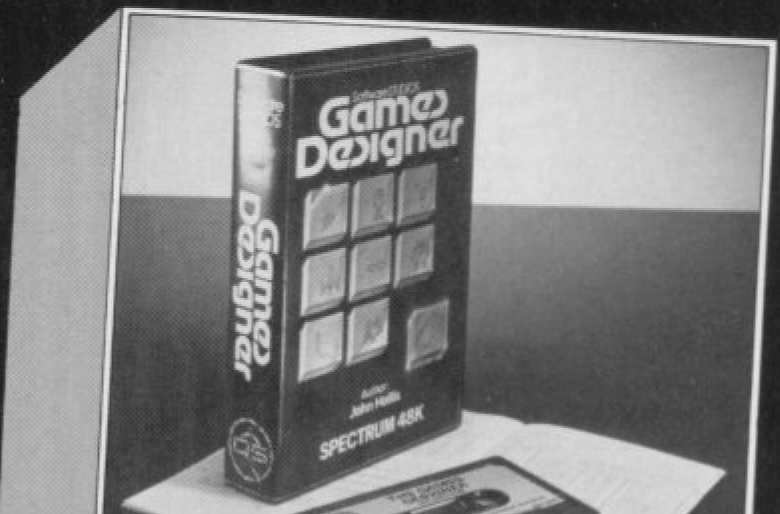
The Hilderbay unit stands or falls on its usage. If there is a need in your life for a printer buffer — and you already have a ZX Spectrum — then this interface will satisfy both requirements. It's also rather cheaper than having to fork out £230 for a 64K printer buffer! As a standard interface it offers nothing special, apart from direct compatibility with all of Hilderbay's software.

There are other printer interfaces around — for instance, Softest offer one especially for the Tandy CGP-115. However, as it's a serial-only interface and all the others seem to drive the device quite well, I'm not sure about its value. Unfortunately, the promised review unit failed to appear by the deadline for this survey so no further comment is possible.

The interface you choose should really reflect the uses to which it is going to be put. If all you want is a simple-to-use means of getting a proper printout then the ADS, LPRINT Mk II and Kempston units offer just what you are looking for, provided that the driving software is available. More sophisticated users will find the Morex unit well worth a look and those with other computers to support will find the Hilderbay device attractive from the printer spooler viewpoint. □

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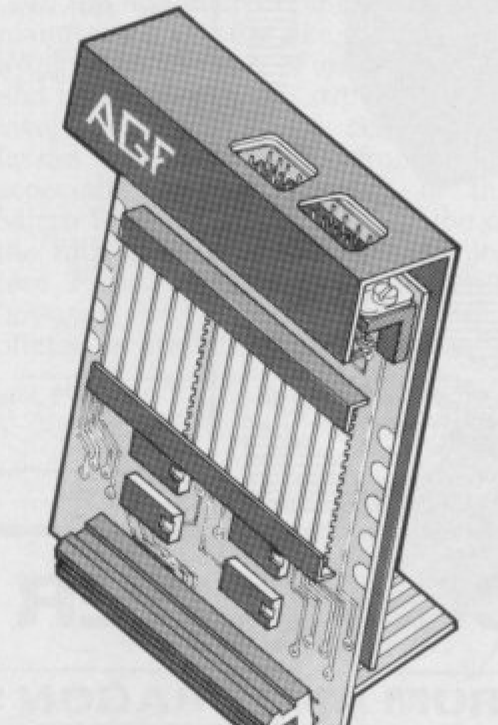
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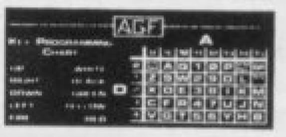


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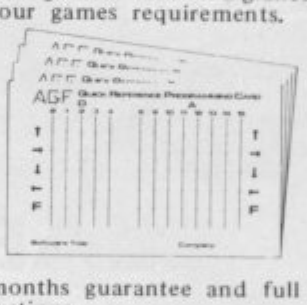
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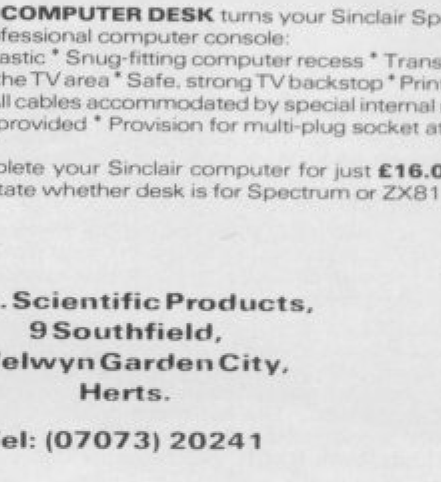
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Machine code is often the stumbling block that stands in the way of those looking to take a more serious approach to Spectrum programming. Books there are a' plenty, but as ever it's horses for courses.* Gary Marshall *looks at the form.

CRACKING THE CODE

It's an indisputable fact that the Spectrum can be made to do just about everything that's possible by programming it in machine code. A claim like that is much harder to make for other programming languages, for instance Basic, because although any computational task can be described, it may not always be performed fast enough.

A program written in any other language than machine code must first be translated into code by the computer before it can be executed — a task which inevitably takes some time. And speed of execution can be reduced further still in circumstances where the computer's translated code has failed to achieve the standards set by an expert human machine code programmer. Consequently, when it comes to speeding things up a bit, machine code is still the best answer. There's also the added advantage that machine code programs are a good deal harder to copy.

Input machine code programs to your Spectrum and you are presenting instructions direct to the Zilog Z-80 microprocessor in the language it understands. The number of instructions in this language is fairly limited and corresponds to the number of operations the microprocessor can perform. But the point is that the programmer deals directly with the electronic hardware, without any recourse to the Basic interpreter. That alone is a very good reason why Spectrum owners should get their hands dirty and find out exactly what's going on in that nifty little box of tricks.

But if all this sounds a bit complicated, not to worry because considerable benefits can be acquired without necessarily going the whole hog. Most Basic programs contain sections which take up a high proportion of the processor's time — elements known as 'critical segments' in the jargon. Programs can be speeded up considerably just by writing these critical segments in machine code.

Finally, before examining the outpourings of various writers on learning the art of machine code programming, it may be worth speculating on whether we ought to be using machine code at all!

In the non-microcomputer world of mainframes and the like, the trend is away from the use of machine code and more towards the structured high level languages. There could be a lesson to be learnt from this, especially with the launch of the Micro Prolog package — a version of the fifth generation language, Prolog (see *Frontlines* this issue). Overall, however, it's fair to say the facilities offered at present by the fifth generation languages are not entirely suitable for the Spectrum user — so there are still one or two good reasons for learning how to program in machine code.

MAKING THE INTRODUCTIONS

There are already a large number of books available to help enthusiasts program the Z-80 processor, mostly written by electronics engineers and hobbyists. A starter book for Spectrum owners should be as good as these, while at the same time staying relevant to the Spectrum and showing readers how to manipulate the hardware.

And, as always, the newcomer also needs a finely structured and carefully paced presentation of reliable information. Of course, encouragement to actually set the fingers tapping is another basic necessity — the best way to learn program writing is not by sitting down and reading about it. Motivation is another problem area



NICK DAVIS

— learning about machine code programming is no bed of roses and even the most manically keen can become discouraged.

Introducing Machine Code by Ian Sinclair provides a gently paced introduction that takes Basic programming as its starting point. Then, by showing how Basic programs are stored and run, it carries on to cover the same areas for machine code. The book introduces a wide range of instructions which are illustrated by way of programming examples. Unfortunately, these example programs rarely turn the spotlight on aspects specific to the Spectrum; in fact, many seem downright incestuous as they are used to examine Basic programs.

The *Ultraviolet* assembler from ACS Software gets a mention and although its use is quite well demonstrated, a more detailed treatment of hand assembly methods would have been better still. Nevertheless, this book would certainly take the reader from zero knowledge to the point where the more advanced machine code texts could take over.

Another introductory tome comes from James Walsh in the shape of *Spectrum Machine Code Made Easy, Volume One*. He includes a number of potentially useful machine code programs for activities specific to the Spectrum — such as scrolling the screen and manipulating colours. He's also not afraid to make good use of some intelligent machine code tricks.

However, despite the quality programming, it would have been better if the author had taken the reader further into the subject. The coverage is not very well structured and the pacing leans towards the erratic; for example, after being lulled into the false sense of security that machine code is *really* easy, after 30 pages the unprepared reader is abruptly launched towards the fairly weighty concepts of Carry, Borrow, Minuend, Subtrahend and two's complement notation!

Most of the programs use instructions before they've been properly introduced and some are not covered at all. For this reason, *Volume One* on its own is rather limited. *Volume Two* (surprise, surprise) is the second and more advanced tutor in the series, which provides much of the necessary reference material you need to fully understand *Volume One*.

In fact there's something of a striking contrast between *Volume One* and *Two* in the *Spectrum Machine Code Made Easy* series. Whereas *Volume One* strolls at a leisurely pace, and is very chatty and highly inventive in its risque chapter and section headings, Paul Holmes' *Volume Two* proves altogether more brisk and workmanlike. It comes packed with machine code routines, and that alone makes it a valuable source of information. The only worrying aspect is whether *Volume One* is fully able to prepare new riders of the machine code plains for the coming demands of *Volume Two*.

But for the complete novice, there's *Spectrum Machine Language For the Absolute Beginner* and although little of it is in fact specific to the Spectrum, the book's treatment of Z-80 code is entirely adequate and there's some useful reference material thrown in for good measure. The text is well sprinkled with examples of machine code used well, and also includes a sizeable games program, along with valuable notes on its development. Your author, however, will decline entering it without an assembler!

Toni Baker's *Mastering Machine Code On Your Spectrum* proclaims itself as championing those who, although familiar with Basic, have no knowledge at all of machine code. But the text fairly rattles along, covering acres of material in a relatively brief time. While there's absolutely nothing wrong with this kind of approach, the feeling is that, rather than a beginner's book, this is for people who know rather more than they're letting on.

Toni conjours up some good programs with interesting applications, including one that produces music from the Spectrum's own speaker. Incredible!

Before moving on to the more advanced titles, there is one last text that you may like to consider should you be starting your machine code career. Tony Woods' *Learn And Use Assembly Language On The ZX Spectrum* provides a complete course in Z-80 assembly language, complete with many illustrative program examples.

MOVE ON UP

The programmer who has paid his or her base level machine code dues may well like the idea of a book that includes ideas for further programs and new techniques, as well as providing a good source of reference. If you manage to find it, let us know! The trouble is that budding beginner's book start to branch out and a great degree of specialisation occurs.

Ian Logan and Frank O'Hara explain exactly what's inside every Spectrum ROM in their book *The Complete Spectrum ROM Disassembly*. It's all there, from how the screen is handled to the way Basic actually works. The book shows the location of all the routines in the ROM, so that programmers are able to call them into their own programs. And because the programs are all listed, the book is also a storehouse of programs and techniques.

Another publication that strikes the same vein is *The Spectrum Machine Code Reference Guide*. Although it didn't arrive in time for review here, the word is it contains a full disassembly listing of the 16K Spectrum ROM as well as a machine code programmer's guide to the Microdrives and Interface 1 unit; it sounds as if it could be worth a look.

Much of the material in Ian Logan and Frank O'Hara's ROM disassembly book appears again in Dr Logan's *Understanding Your Spectrum*. However, there's also useful stuff on how to use subroutines in the ROM, and by far the best reference section on the Z-80 instruction set your author has seen. The text also provides valuable data on the available assembler and disassembler packages.

Last of all in our round-up, there's *Super Charge Your Spectrum* by David Webb. This is essentially a library of machine code programs, on hand for liberal sprinkling into Basic programs as and when required. Included amongst this amazing collection is a routine for developing Basic programs, and a number of useful utilities, for instance, a renumberer.

CONCLUSIONS

Your author has to admit a slight disappointment with the beginners' books. None seemed as good as the 'professional' Z-80 texts available, although in fairness this is compensated by the fact that they are specifically designed to be used with the Spectrum.

The more advanced books, however, have no apologies to make. They show exactly what the Spectrum can do, and how it can be made to do it, and all are intimately linked to the Spectrum. If ever you feel in need of encouragement as you stumble slowly through the early steps, check out the more advanced titles and see what you're missing. Inspiration – and motivation should soon follow. ☐

WE LOOKED AT...

Introducing Spectrum Machine Code by Ian Sinclair, Granada, ISBN 0 246 12082 7, £7.95

Spectrum Machine Code Made Easy, Volume One by James Walsh, Interface Publications, ISBN 0 907563 43 0, £5.95

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VARIABLES ON A THEME

System variables are bytes in memory which help the Spectrum remember certain things it needs to know about itself — if you like, the housekeeping routines. Delve deeper into the Spectrum ROM with* Dilwyn Jones *in this, the first of two articles which investigate the complete available set of system variables, giving comprehensive guidelines as to what you can and can't do with them.

PART ONE

The system variables are bytes in the Spectrum ROM which allow the computer to know all the things it should do to operate in the way you've come to expect. The information, such as how the Spectrum's memory is laid out, is held in the system variables in these addresses so that the computer can get hold of it and update it as and when required.

We can make use of the information stored in these memory locations in our programs, either by reading information already there or changing it to make the computer do something it might not otherwise do, or sometimes do it more easily.

Not all of them are that much use to us. And certainly not all of them ought to be changed. Some will cause the computer to crash, or the computer may simply ignore you. Some can be happily changed under certain circumstances only, and most within strict limitations. I hope to give you some guidelines as to what can and can't be done, but hopefully you will learn your own little PEEKs and POKEs in time as well.

23552 to 23559 KSTATE reading the keyboard

When the processor is interrupted (50 times every second in the UK normally) one of the things done is to read the keyboard and store the results here. The bytes have different uses. Not all can be practically used by the programmer. You can use this program to examine what's going on in the eight bytes of KSTATE. Run it and press various keys to see what effect individual keys have, such as the Shift keys, and what effect going from one key to another has.

```
10 FOR A=23552 TO 23559
20 POKE 23692,0: REM KEEP SCROLLING
30 LET B=PEEK A
40 PRINT A; TAB 10;B; TAB 20; CHR$ B AND
   B>31
50 NEXT A
60 GO TO 10
```

The first four bytes of KSTATE deal with something called 'two key rollover' which allows you to press a second key before you actually let go of the first. The descriptions given to the main four bytes, 23556 to 23559, will apply to the first four also as long as you bear in mind that these only come into operation for two key rollover. PEEK 23556 can return the code of the upper case version of the key pressed, so if you pressed Symbol Shift A you would get the code of 'A', not the code of 'a' nor the code of 'STOP'.

This may be useful where it is essential that upper case be entered, etc. The effect of pressing a key is temporary and lasts only as long as the key is being pressed. The value in 23556 would be 255 if no key was being pressed at the time the interrupt had occurred. For the Enter key, a value of 13 is returned. For the Space key, a value of 32 is returned. Pressing both Shift keys simultaneously produces 14. This program will demonstrate this:

```
10 LET A=PEEK 23556
20 POKE 23692, 0
30 PRINT A, CHR$ A AND A>31
40 GO TO 10
```

23557 is used for timing to prevent intermittent key contact, etc, causing problems — known as keyboard debouncing.

23558 is the auto repeat timer which times the pause before the keys start repeating, then the pause between repeats once the key has actually started repeating. The delays used are those in the system variables that hold these delays (23561/2).

23559 contains the code of the last character pressed on the keyboard. This depends on whether the Shift keys were pressed or not. The numbers produced are those that would be returned by PRINT CODE INKEY$ except that these are the last key pressed and not necessarily the key currently being pressed. Try this program to display what can happen — RUN it and try pressing various keys making use of the Shift keys.

```
10 LET A=PEEK 23559
20 POKE 23692, 0
30 PRINT A, CHR$ A AND A>31
40 GO TO 10
```

See also under 23611 FLAGS.

23560 LASTK Newly pressed key

Every time the keyboard is scanned, a key is found to have been pressed and proved valid, the value of this system variable is updated. Its content is the code of the last key pressed.

This system variable does not really do much you could not do with INKEY$, except that it could be used to type ahead one character. If you try this program, you will find that if you press a key when invited to do so, the key is indicated on the screen in a short while even though the program may not have got as far as line 50 when you pressed a key. The code of the last key pressed is stored here and stays here until another key is pressed. It is possible to test for a newly pressed key by examining bit 5 of the system variable FLAGS 23611. This would be '1' for a key just pressed.

```
10 PRINT "Press a key now"
20 FOR A=1 TO 900
30 NEXT A
40 CLS
50 LET A=PEEK 23560
60 PRINT A: IF A>31 THEN PRINT CHR$ A
```

This could be used for testing for a y/n (yes or no) type situation — if you knew one was coming up, you could indicate your response before the program got there and the program would respond when it got round to it. Also, if two keys were pressed simultaneously, the program would respond if one were released without having to wait for the keyboard to be released completely.

Control characters can be generated using Caps Shift in conjunction with the number keys. Enter returns 13. Pressing both Shift keys together returns 14. To see this, try this program:

```
10 LET A=PEEK 23560
20 PRINT A, CHR$ A AND A>31
30 GO TO 10
```

23561 REPDEL Repeat delay

This system variable contains the length of time that a key must be held down before it starts to auto-repeat. The time

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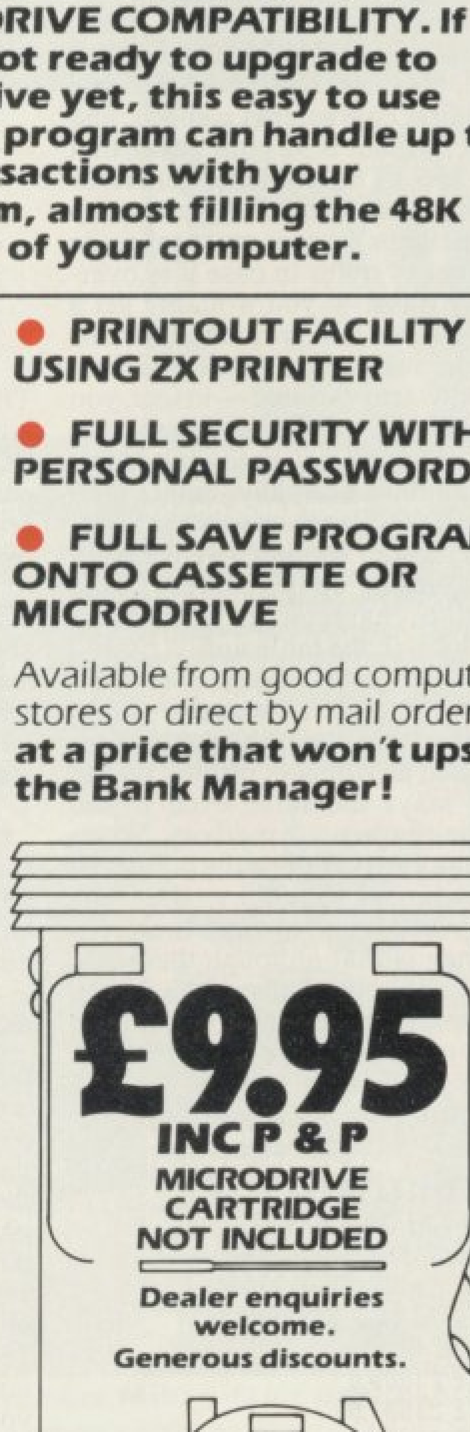
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VARIABLES ON A THEME

delay in the UK is one-fiftieth of a second and starts off at 35/50 of a second. You can happily POKE this if, for instance, you want the key to start repeating immediately. The cursors become rather difficult to control if you, say, POKE 23561,1. POKE 23561,0 effectively turns off the auto-repeat, actually giving a delay of about five seconds like POKE 23561,255.

23562 REPPER delay between repeats

This system variable controls the length of time between repeats once the auto-repeat has actually begun. The time is in fiftieths of a second in the UK. If you effectively want to turn off the auto-repeat for any reason, POKE 23562,0 or POKE 23562,255 gives about five seconds between repeats. If you wish to edit long program lines (eg. a long PRINT statement) then POKE 23562,1 will speed up moving the cursor to the right place. But beware of changing 23562 too much at the same time or you may speed up the cursor so much it becomes difficult to control. Its normal value is 5/50 to a second or one tenth of a second.

23563/4 DEFADD

The address of the argument of a user-defined function in a program, ie. if you had DEF FN A(B) in a program line, the value in 23563/4 would be the address of the letter B in the brackets in that line while only the function is being used. The best way to PEEK into 23563/4 to show this is to put the PEEK as a part of the FN to be evaluated as there is always a zero there unless the function is being evaluated. So the line:

```
10 PRINT PEEK 23563+256*PEEK 23564
```

would always return zero. On the other hand:

```
10 DEF FN A(B)=PEEK 23563+256*
   PEEK 23564
20 PRINT FN A(999)
```

would return the address of the B in line 10. The 999 is not significant, just something to actually give a value to B to prevent an error. In the case of a function with no argument:

```
10 DEF FN A()=PEEK 23563+256* PEEK
   23564
20 PRINT FN A()
```

this would print the address of the closed bracket symbol.

23568 to 23605 STRMS

The first 14 bytes on a basic Spectrum contain addresses relating to channels and streams. Streams −3 to +3 are stored in two bytes each.

23606/7 CHARS

This system variable has as normal values:

23606 contains 0
23607 contains 60

This system variable points to the start of the character set that the computer uses for printing on the screen and the printer. SCREEN$ also uses this system variable. The normal address pointed to is 15360 which is 256 less then the address of the start of the ROM character set. (256 less because the character generator is accessed by something similar to PEEK 23606 + 256 * PEEK 23607 + CODE "A" * 8 and since the first character is a space, and the code of a space is 32 you can see that 8 * 32 is 256.) The character generator is 768 bytes long, so if you wish to set up a new character set you must set aside this number of bytes in case it is overwritten by Basic — you wouldn't get a crash, you'd just end up with gibberish.

Mention was made of SCREEN$ using this system variable — in fact, you may be aware of the problem that SCREEN$ does not recognise user-defined graphics normally, unless they happen to be similar to an existing Spectrum character. In fact, SCREEN$ works by picking up the address of the start of the character generator and looking through the table until it finds a matching character. Now since the Spectrum screen is bit-mapped rather than memory-mapped like some computers, once anything is printed on the screen it stays the same even if you change the character in memory. So we could temporarily change the pointer to the character set to point to the user-defined graphics and look up there.

One snag is that although there is a system variable that tells us where the user-defined graphics start, this address is 256 or more — so we must subtract 256. This conveniently means we subtract one from the high byte. This program should demonstrate:

```
10 FOR X=144 TO 164
20 PRINT AT 0,0; CHR$ X
30 POKE 23606, PEEK 23675
40 POKE 23607, PEEK 23676-1
50 PRINT AT 20,0; SCREEN$ (0,0)
60 PAUSE 40
70 POKE 23606,0
80 POKE 23607,60
90 NEXT X
```

What we did was make the computer think the user-defined graphics are the normal character set. SCREEN$ will still produce characters with codes of 32—127, although this is easily overcome with a bit of fiddling. Since SCREEN$ starts off with CHR$ 32 and the UDGs start off at 144, we would need to add 112 to return characters in the range of the user-defined graphics.

Here is one way to do this. X is the x co-ordinate across the screen and Y and y co-ordinate down the screen of the location SCREEN$ is to examine. A check is first of all made that SCREEN$ does not find one of the normal characters there, then returns if one is found. The character at Y, X is returned in A$. Line 8025 is needed only if you are using a character set other than the ROM one. If you are using the ROM character set, then delete line 8025 and replace lines 8070 and 8080 with the alternative versions that follow.

```
8000 REM SCREEN$ FOR UDG'S
8010 LET A$=SCREEN$ (Y,X)
8020 IF A$() "" THEN RETURN
8025 LET A=PEEK 23606: LET B=PEEK
     23607
8030 POKE 23606, PEEK 23675
8040 POKE 23607, PEEK 23676-1
8050 LET A$=SCREEN$ (Y,X)
8060 IF A$() <>"" THEN LET A$=CHR$$
     (CODE A$+112)
8070 POKE 23606,A
8080 POKE 23607,B
8090 RETURN

8070 POKE 23606,0
8080 POKE 23607,60
```

The story does not finish there. There are only 21 user-defined graphics — if SCREEN$ does not find a match, it will continue looking up past the user-defined graphics until it has finished looking for the 32 to 127 range it thinks it's looking for. This could be embarrassing if there just happend to be some data stored above the UDGs for any reason which resembled any character. To help prevent this happening, although the UDGs are normally at the top of RAM anyway, this line could be added:

```
6065 IF A$>CHR$ 164 THEN LET A$=""
```

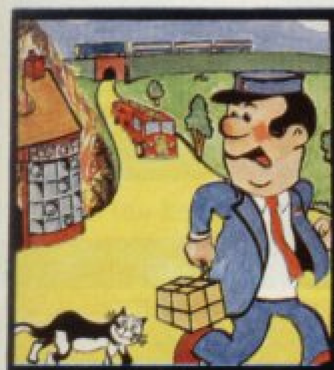
Incidentally, you should ensure that 23606/7 always points to the right character set when PRINTing, LISTing, etc, is done.

23608 RASP

Controls the duration of the buzz that sounds to warn you that you are running out of memory. At switch-on, this has a value of 64. This can be altered, but there seems little point. POKE 23608,0 gives a very short click rather than a buzz — useful if you hate the buzz that satirically mocks you when you run out of memory. Alternatively, POKE 23608,255 gives a very long buzz which immobilises the keyboard, preventing you typing any further than when the buzz sounded.

23609 PIP

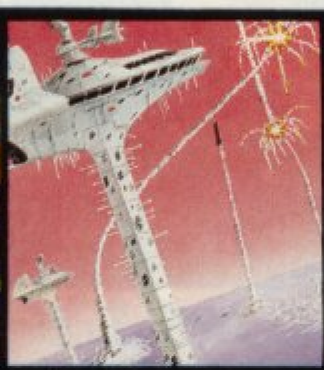
Controls the length of the click emanated when a key is pressed in command mode or during an INPUT. It starts off at zero but may be changed. Any value between 30 and about 130 gives a pleasant, more audible bleep rather than the quieter click normally given. Values high than 130 tend to noticeably slow



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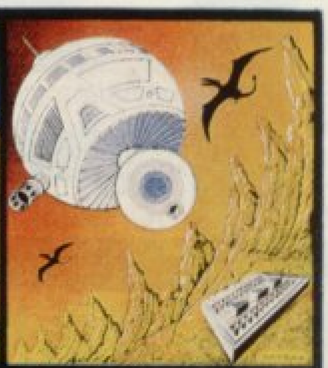
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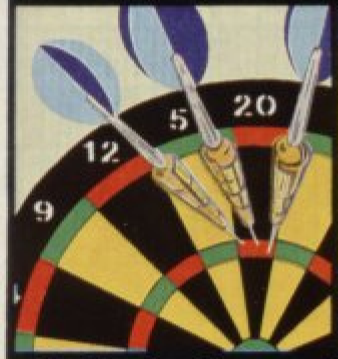
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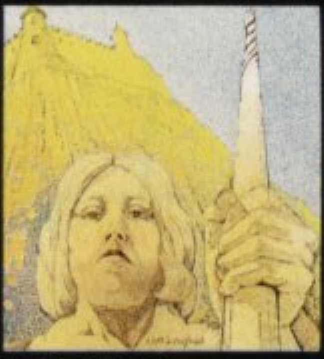
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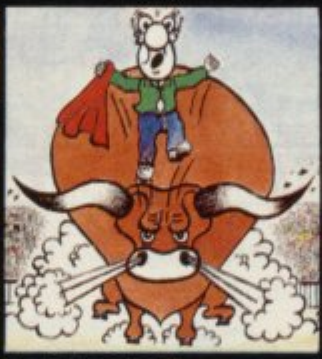
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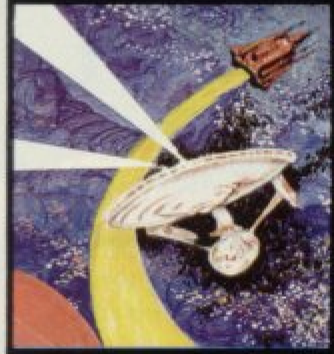
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VARIABLES ON A THEME

down the keyboard response (since computing stops as the bleep is sounded). Usually, the one to use is POKE 23609,100.

23610 ERR NE

Controls error report number and normally has a value of 255 unless an error arises, when it contains one less than the error report codes printed, eg. for error 4, out of memory, it would contain a three. The message printed out is contained in ROM starting at address 5010 decimal. The end of the message is signified by the last character in the message having bit 7 set to a one. After the error message comes the '© 1982 Sinclair Research Ltd.' message that you see after switch-on or NEW. You can POKE 23610 to generate an error to stop the program, but since the message printed is fixed and in ROM, you may end up with garbage.

If you wanted to simulate an 'out of memory' error you would end a program with POKE 23610,3. This would not work as any program line; you'd have to ensure that it was the last line, as once a condition arises to end a program, only then is 23610 looked at to determine what is printed.

23611 FLAGS

This system variable contains various flags controlling the Basic system and generally should not be POKEd. However, some of the flags can be usefully PEEKed.

Bit 0: Being a one indicates no space to be printed before the next keyword.

Bit 1: This bit being set to a one indicates that the print output is to be send to the printer. A zero would mean it is to be sent to the TV screen.

Bit 5: Any newly pressed key is indicated by its code being stored in 23560 (the LASTK system variable) and bit 5 of 23611 (FLAGS) is set to indicate that a new key has been pressed.

Bit 7: Syntax flag.

These will be of more use when using ROM routines in a machine code program.

23613/4 ERR-SP

Keeps track of the address on the machine stack where the appropriate return data lies. Try calling a few GOSUBs with no matching RETURNs and watch this point down the memory. Now you can see what happens and why this occurs when you run out of memory in a situation like this. Also, try PEEKing the contents of the three addresses (the base of which is pointed to by 23613/4) to see what return data actually consists of.

```
10 LET A=PEEK 23613+256*PEEK
   23614
20 PRINT PEEK A; TAB 10; PEEK (A+1);
   TAB 20; PEEK (A+2)
```

23617 MODE

Specifies cursor. Values zero, one, two or four specify the L/C mode, E mode, G mode or K mode respectively. POKEing this system variable will affect the appearance of the cursor — it may appear as a flashing letter, number, symbol or even a keyword. This is most apparent during an INPUT statement. The value is reset when the need arises, eg. a mode change made normally from the keyboard. So if you get into difficulties, press both Shift keys for E mode and then the same again to get back to normal L/C mode.

Try this program which POKEs all possible values into 23617. Most are variants on the four cursors, ie. you will find yourself in a particular mode after the POKE, such as everything coming as graphics as in G mode. 252 will give an L/C mode flashing '<' to point to where you're typing . . .

```
10 FOR A=0 TO 255
20 PRINT A
30 POKE 23617,A
40 INPUT A$
50 NEXT A
```

23618/9 NEWPPC and 23620 NSPPC

23618/9 is a two-byte system variable containing the line number of the line to be jumped to. 23618 contains the lower byte of the line number and 23619 the higher, so the line number contained is read as PEEK 23618 + 256 * PEEK 23619. To POKE a line number in, say line X:

```
POKE 23618, X-256*INT (X/256)
POKE 23619, INT (X/256)
```

We now come to system variable 23620. With 23618/9 and 23620, we could actually simulate a GOTO command to a statement within a program line, should that ever be necessary. GOTOs cannot access individual statements within long program lines.

To jump to statement four in line X, first go through the motions described above then POKE 23620,4 and the jump is executed.

23624 BORDCR

The bits of this system variable control the attributes of the lower screen and the BORDER colour. Take a look at *Table 1*.

By POKEing various values into this system variable you could achieve a flashing, bright, multicoloured lower screen, or make both PAPER and INK the same colour to prevent other people getting at your programs — however, any alteration would have to be made blind. You could also make INPUTs extra bright to stand out.

23627/8 VARS

The pointer to the start of the variables store. Apart from finding your way into the variables area, you can find the length of the Basic program with this expression. This excludes screen, system variables, stacks and variables.

```
LET bytes=PEEK 23627+256*PEEK 23
628-PEEK 23635-256*PEEK 23636
```

23629/30 DEST

The address of the variable when it is assigned to. If the variable had been set up before, it would point to the start of where it was stored in the variables area. If it was being defined for the first time, it would point to the address of the start of the name of the variable in the program, eg. in 10 LET A = 5, it would point to the address of the letter A.

It can also be used to find the memory address of a numeric variable, if you use something like LET A = A as in the following program:

```
10 LET A=5
20 LET A=A
30 PRINT PEEK 23629+256*PEEK 23630
```

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
FLASH lower screen	lower screen BRIGHT	BORDER colour and lower screen PAPER			lower screen INK		

Table 1. The bits of system variable 23624 control the attributes of the lower screen and the BORDER colour.

23631/2 CHANS

Stores the address of where the channel information area starts.

23633/4 CHURCHL

The address of INPUT/OUTPUT information used at that moment. It normally points during an INPUT/OUTPUT operation to a five byte block of data in the channel information area. Use this program to examine the contents.

```
1 FOR X=0 TO 3: PRINT #X; PEEK
  23633+256*PEEK 23634: NEXT X:
  PAUSE 0: STOP
```

This article is extracted from Dilwyn Jones' book, *Beyond Simple Basic — Delving Deeper Into Your ZX Spectrum*. This book was first published by Interface Publications, 9-11 Kensington High Street, London W8 6EJ, and is priced at £7.95.

PLAY POWER!

Spectrums at the ready for some financial fun with* Peter Young *and a riotous road race with* Danny Sheehan. *And just in case you don't want to miss that vital appointment, you'd better key in* Ian Turtle's *machine code gem first.

STOCKMARKET

Fancy yourself as a budding financial genius — well, here's your chance to prove it. Dealing in stocks and shares, your task is to make a veritable fortune anticipating the 'bears' and 'bulls' in the stock market.

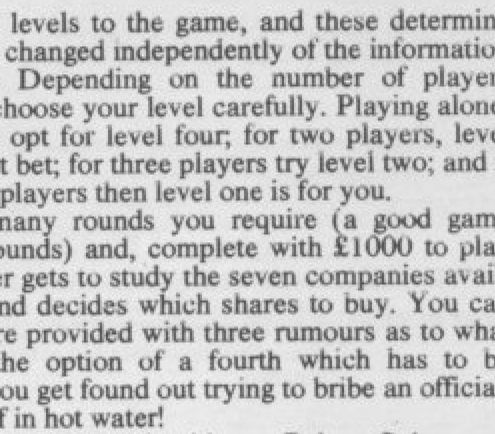
There are four skill levels to the game, and these determine how much prices have changed independently of the information given to the players. Depending on the number of players involved, you should choose your level carefully. Playing alone, you would be wise to opt for level four; for two players, level three would be the best bet; for three players try level two; and if there are four or more players then level one is for you.

You specify how many rounds you require (a good game would comprise six rounds) and, complete with £1000 to play the market, each player gets to study the seven companies available for speculation and decides which shares to buy. You can 'cheat' a little as you're provided with three rumours as to what might happen, with the option of a fourth which has to be bought. Of course, if you get found out trying to bribe an official, you could find yourself in hot water!

You'll notice that the shares in Akran, Belso, Cobra and Dobro will not fluctuate too much each round, whereas speculations on Elsat and Finet will turn out a lot more lucrative. The final company, Bchip, represents the kind of share which never actually falls in value, but whose gradual rise in price will never make you a Nelson Rockefeller.

All prompts for the buying and selling of shares are indicated on-screen, and the program is error-trapped should you decide to type in a lot of nonsense! When all players have completed their various transactions, the Spectrum will list any changes of share values and inform those unlucky enough to let their funds go down to £0 that they'd better reserve themselves a place on the window-ledge.

You are presented with a chart detailing the seven companies, along with their respective share prices and the rumours you should base your speculations on. Who knows, you could end up a Nelson Rockefeller — of course, it's not so far to Skid Row either!



Should a company be dissolved, all shares in this enterprise will be discontined and you stand to lose all your cash. However, you will find that the company will re-emerge due to an influx of government subsidy and trade will continue with the share prices being set to their original starting price of £15. After the final game turn, the program converts all shareholdings into cash and gives each player his or her final tote — the winner, of course, being the one who has made the biggest fortune.

```
   1 REM stock market by P.YOUNG
  10 INK 0: PAPER 7: BORDER 7: CLS : POK
E 23609,50: POKE 23658,8
  15 PRINT AT 10,3; PAPER 1; INK 6;"STOC
K MARKET P.YOUNG  1983"
```

Lines 1-15 Initialise screen colours, POKE Caps Lock and keyboard bleep, and finally PRINT the game title.

```
  20 LET BRIBEATTEMPT=0: LET GAMETURN=1
```

Line 20 Sets the initial values of the bribe attempt and the game turn.

```
  21 PRINT £1;"SKILL LEVEL (1-4) ?";: GO
 SUB 9100: LET LEVEL=VAL K$: PRINT £1;CH
R$ 8;K$
  22 PRINT £1;"NUMBER OF PLAYERS ?";: GO
 SUB 9100: LET NUMOFPLAYERS=VAL K$: PRIN
T £1;CHR$ 8;K$
  23 PRINT £1;"NUMBER OF GAME TURNS ?";:
 GO SUB 9100: LET GAMELENGTH=VAL K$: PRI
NT £1;CHR$ 8;K$
```

Lines 21-23 Get the details of the number of players, skill level, and the number of game turns required. The subroutine starting at line 9100 (called no less than three times within this short routine) reads the keyboard.

```
  25 RANDOMIZE : GO SUB 8000
  30 GO TO 100
```

Lines 25-30 Call the variable subroutine and jump to the main program.

```
  40 BEEP .3,0: BEEP .3,3: BEEP .3,5: BE
EP .3,0: CLS
  42 PRINT AT 0,0; INVERSE 1;"SHARE  VAL
UE AVAIL  HOLD  S TRND"
  43 LET L=1
  45 FOR R=3 TO 15 STEP 2: PRINT AT R,0;
N$(L);AT R,7;"`";AT R,9;S(1,L);AT R,29;S
(3,L): IF S(4,L)<>1 THEN  PRINT AT R,27;
S(5,L): PRINT AT R,26;"S": GO TO 48
  46 PRINT AT R,26;"N"
  48 LET L=L+1: NEXT R
  60 RETURN
```

Lines 40-60 Contain a subroutine to print screen details. This is positioned at the beginning of the program to speed up the proceedings.

```
 100 REM MAIN LOOP
 105 GO SUB 40
 110 FOR N=1 TO NUMOFPLAYERS: GO SUB 120
: GO SUB 150: GO TO 210
 120 PRINT AT 1,10; PAPER 5;"PLAYER  ";N
 125 LET HOLD=1
 130 FOR R=3 TO 15 STEP 2: PRINT AT R,14
;S(2,HOLD);AT R,21;P(HOLD,N);"  ": LET H
OLD=HOLD+1: NEXT R
 140 PRINT AT 16,26;"      ": PRINT AT 16
,2; PAPER 5;"READY CASH ON TURN ";GAMETU
RN;"    ";P(8,N): RETURN
 150 PRINT AT 18,0; PAPER 6;"RUMOURS": F
OR R=18 TO 20: GO SUB 6000: NEXT R
 152 PRINT AT 21,10;"
   "
 155 LET BRIBE=10+5*INT (RND*5)
 160 PRINT £1;AT 1,0;"BRIBE OFFICIAL FOR
 `";BRIBE;" ? ": GO SUB 9100: LET Y$=K$
 165 IF Y$<>"Y" AND Y$<>"YES" AND Y$<>"N
" AND Y$<>"NO" THEN  GO TO 160
 170 IF Y$="Y" OR Y$="YES" THEN  LET BRI
BEATTEMPT=1: LET R=21: GO SUB 6000
 180 LET BRIBEATTEMPT=0
 190 RETURN
 210 GO SUB 5000
 220 NEXT N
 225 GO SUB 4000: FOR N=1 TO 6: IF S(5,N
)<>0 THEN  LET S(4,N)=2
 227 NEXT N
 230 LET S(3,7)=INT (RND*3): REM BCHIP I
NCREASE (IF ANY)
 240 FOR N=1 TO 7: LET S(1,N)=S(1,N)+S(3
,N): IF S(1,N)<=0 THEN  GO SUB 7000
 245 IF S(1,N)>40 THEN  LET S(1,N)=40
 250 NEXT N
 260 FOR N=1 TO 6: IF S(4,N)=2 THEN  LET
 S(5,N)=S(5,N)-1: IF S(5,N)=0 THEN  LET
S(4,N)=1: REM CHECKS SUSPENDED SHARES
 270 NEXT N
 280 GO SUB 40: PRINT AT 1,10; PAPER 5;"
NET MOVEMENT": PRINT AT 17,3; PAPER 6;"P
RESS ANY KEY TO CONTINUE": PAUSE 0
 300 LET GAMETURN=GAMETURN+1: IF GAMETUR
N=GAMELENGTH THEN  PRINT AT 19,10; INVER
SE 1;"LAST TURN COMING UP"
 310 IF GAMETURN>GAMELENGTH THEN  GO TO
9000
 320 FOR N=1 TO 6: LET S(3,N)=INT (0.5+(
.5*S(3,N))): IF S(1,N)=40 THEN  LET S(3,
N)=0
 330 NEXT N: LET S(3,7)=0: GO TO 105
```

Lines 100-330 Main program loop. This is called once per turn for each player. This portion of the code prints the screen, rumours, and bribe attempts if necessary.

```
4000 REM COMPUTER RUMOURS
4010 CLS : PRINT AT 3,0; PAPER 5;"RUMOUR
S UNKNOWN TO PLAYERS"
4020 FOR R=7 TO 6+LEVEL: LET RAN1=1+INT
(RND*47): GO SUB 6012: NEXT R
4025 PAUSE 150
4030 RETURN
```

Lines 4000-4030 Unknown rumours routine. This routine calculates the extra rumour.

```
5000 REM PLAYER ACTIONS
5010 PRINT AT 17,0; PAPER 2; INK 7;" TYP
E ""E"" TO FINISH THIS PHASE  "
5020 PRINT £1;AT 0,0;"
         TRANSACTION- SELL OR BUY
    ": GO SUB 9100: LET Y$=K$
5025 IF Y$="E" THEN  PRINT £1;AT 1,0;"O.
K.  -YOUR TURN OVER          ": PAUSE 150
: RETURN
5027 IF Y$="S" OR Y$="B" THEN  GO TO 503
0
5029 GO TO 5020
5030 INPUT "NUMBER OF SHARES ";NUM
5040 INPUT "COMPANY NAME "; LINE C$: FOR
 L=1 TO 7: IF C$=N$(L) THEN  GO TO 5050
5045 NEXT L: PRINT £1;AT 0,0;"NO SUCH CO
MPANY AS ";C$," -TRY AGAIN": PAUSE 150:
GO TO 5020
5050 IF S(4,L)<>1 THEN  PRINT £1;AT 1,0;
"SHARES SUSPENDED     ": PAUSE 150: GO TO
5020
5055 IF Y$="S" THEN  GO TO 5100
5057 IF Y$<>"B" THEN  GO TO 5020
5060 IF NUM>S(2,L) THEN  PRINT £1;AT 0,0
;"THERE ARE NOT ";NUM," SHARES AVAILABLE
": PAUSE 150: GO TO 5020
5070 IF P(8,N)<S(1,L)*NUM THEN  PRINT £1
;AT 0,0;"YOU HAVEN'T ENOUGH MONEY": PAUS
E 150: GO TO 5020
5080 LET S(2,L)=S(2,L)-NUM: LET P(L,N)=P
(L,N)+NUM: LET P(8,N)=P(8,N)-(S(1,L)*NUM
): BEEP .25,0: PRINT £1;AT 0,0;NUM;" SHA
RES BOUGHT IN ";C$;" COST-  `";S(1,L)*NU
M: PAUSE 200
5090 PRINT AT 1+L*2,14;S(2,L);"  ": PRIN
T AT 1+L*2,21;P(L,N);"  ": GO SUB 140: G
O TO 5020
5100 IF NUM>P(L,N) THEN  PRINT £1;AT 0,0
;"YOU DO NOT HAVE ";NUM;" SHARES IN ",C$
;" TO SELL": PAUSE 150: GO TO 5020
5110 LET P(8,N)=P(8,N)+NUM*S(1,L): LET S
(2,L)=S(2,L)+NUM: LET P(L,N)=P(L,N)-NUM:
 PRINT £1;AT 0,0;NUM;" SHARES SOLD IN ";
C$;" FOR  `";S(1,L)*NUM: PAUSE 200: GO TO
 5090
```

Lines 5000-5110 Contain the buying and selling of shares routine. Each player is asked if they want to buy or sell shares. Checks are made on the number of shares available and the amount of cash the player has — this information is used to stop 'illegal entries', ie. cheating.

```
6000 REM INFO GIVEN TO PLAYERS
6005 IF BRIBEATTEMPT=1 THEN  LET P(8,N)=
P(8,N)-BRIBE: GO SUB 140: IF RND>.8 THEN
  GO TO 6180
6010 LET RAN1=1+INT (RND*49)
6012 IF RAN1>32 THEN  GO TO 6070
6015 LET RAN1=1+INT (RND*8)
6020 IF M(RAN1)>0 THEN  LET W$="UP": GO
TO 6040
6030 LET W$="DOWN"
6040 LET RAN2=1+INT (RND*4)
6050 LET S(3,RAN2)=S(3,RAN2)+M(RAN1)
6060 PRINT AT R,10;N$(RAN2);" ";W$;" `";
ABS M(RAN1);"        ": RETURN
6070 IF RAN1>42 THEN  GO TO 6120
6080 LET RAN1=9+INT (RND*5)
6090 IF M(RAN1)>0 THEN  LET W$="UP": GO
TO 6110
6100 LET W$="DOWN"
6110 LET RAN2=5+INT (RND*2): GO TO 6045
6120 IF RAN1=43 THEN  FOR L=1 TO 6: IF S
(4,L)=1 THEN  LET S(3,L)=S(3,L)+2: NEXT
L: PRINT AT R,10;"ALL SHARES UP `2
": RETURN
6130 IF RAN1=44 THEN  FOR L=1 TO 6: IF S
(4,L)=1 THEN  LET S(3,L)=S(3,L)-2: NEXT
L: PRINT AT R,10;"ALL SHARES DOWN `2
": RETURN
```

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```
6140 IF RAN1>=48 THEN  GO TO 6160
6150 LET RAN2=1+INT (RND*6): LET S(5,RAN
2)=2+INT (RND*3): PRINT AT R,10;N$(RAN2)
;" TO BE SUSPENDED": RETURN
6160 PRINT AT R,10;"LIFT SUSPENSION- ":
INPUT "ENTER COMPANY ";Y$: FOR L=1 TO 6:
 IF Y$=N$(L) THEN  GO TO 6175
6170 NEXT L: PRINT AT R,27;"NONE": RETUR
N
6175 LET S(4,L)=1: LET S(5,L)=0: PRINT A
T R,27;Y$: PRINT AT 1+L*2,26;"N ": RETUR
N
6180 LET RAN1=1+INT (RND*4)
6190 LET P(8,N)=P(8,N)-50*RAN1
6200 PRINT AT R,10;"FINED `";50*RAN1;" F
OR BRIBERY": PAUSE 100: GO SUB 140
6220 RETURN
```

Lines 6000-6220 Calculate and print information on the rise and fall of shares, and also the suspension of shares.

```
7000 REM BANKRUPT COMPANY
7010 FOR L=1 TO NUMOFPLAYERS: LET P(N,L)
=0: LET P(N,L)=0: NEXT L
7020 LET S(1,N)=15: LET S(3,N)=0: LET S(
4,N)=1: LET S(2,N)=100: LET S(5,N)=0
7030 BEEP .4,0: BEEP .3,0: BEEP .2,0: BE
EP .4,0: BEEP .4,3: BEEP .2,2: BEEP .3,2
: BEEP .2,0: BEEP .3,0: BEEP .2,-1: BEEP
 .4,0: PRINT AT 18,0;"SHARES IN ";N$(N);
" LOST-BANKRUPTCY": PAUSE 130
7040 RETURN
```

Lines 7000-7040 Check to see if a company is bankrupt, and plays a merry little ditty when all is lost.

```
8000 REM INITIALISATION
8010 DIM M(14): DIM N$(7,5)
8020 FOR N=1 TO 14: READ M(N): NEXT N
8030 DATA -4,-3,-2,-1,1,2,3,4,6,4,2,-10,
-8,0
8040 FOR N=1 TO 7: READ N$(N): NEXT N
8050 DATA "AKRAN","BELSO","COBRA","DOBRO
","ELSAT","FINET","BCHIP"
8110 DIM S(5,7): DIM P(8,NUMOFPLAYERS):
DIM W$(4)
8120 FOR L=1 TO 7: LET N=1
8130 LET S(N,L)=15
8140 LET S(N+1,L)=100
8150 LET S(N+2,L)=0
8160 LET S(N+3,L)=1
8165 LET S(N+4,L)=0
8170 NEXT L
8175 LET S(1,7)=10
8180 FOR L=1 TO 7: FOR N=1 TO NUMOFPLAYE
RS
8190 LET P(L,N)=0: NEXT N
8200 NEXT L
8210 FOR N=1 TO NUMOFPLAYERS: LET P(8,N)
=1000: NEXT N
8220 RETURN
```

Lines 8000-8220 Initialisation of variables.

```
9000 REM END OF GAME
9005 CLS : PRINT AT 1,10; PAPER 6;"END O
F GAME"
9010 LET R=4
9020 FOR N=1 TO NUMOFPLAYERS
9030 FOR L=1 TO 7: LET P(8,N)=P(8,N)+S(1
,L)*P(L,N): NEXT L
9040 PRINT AT R,0;"PLAYER ";N;" FINISHED
 WITH ` ";P(8,N);: LET R=R+4
9050 NEXT N
9060 STOP
```

Lines 9000-9060 The 'end of game' routine. This prints details of who has what at the end of the game, cashing shares and announcing who has made the most of their opportunity.

```
9100 REM GET KEY
9110 PAUSE 1: PAUSE 0
9120 LET K$=INKEY$
9130 RETURN
```

Lines 9100-9130 Wait for a key to be pressed, returning to the main program with the string, K$, holding the necessary data.

```
9997 REM Do not type in lines 9997-9999
9998 CLEAR : ERASE "m";1;"Stocks"
9999 SAVE *"m";1;"Stocks"
```

Lines 9997-9999 A SAVEing routine for those of you who have purchased ZX Microdrives. Do not type in these lines unless you have Microdrives.

ROAD RACER

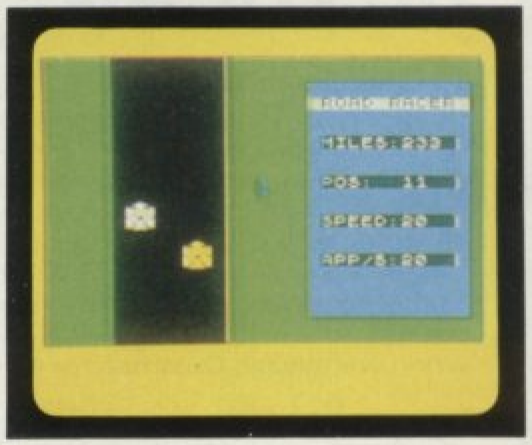
Careering along in first place in a 600 mile road race, your white 'turbo' car hits disaster and a call into the pits is demanded. Starting off again, you find yourself in tenth position with everything to go for.

On-screen, you will see the road stretching out in front of you, plus a dashboard which provides you with all the necessary information you'll need to catch the cars in front. The dash' gives you your current speed (0-99 mph); your position in the race; the speed of the approaching car; and the number of miles the leader has to finish the race — so you'll know exactly what kinda' trouble you're in.

The secret of success is to be aware at all times of the speed of the approaching cars — and also, how to handle the cars behind you that want to overtake (sorry, no oil slicks in this program!). As you get nearer the leader, take special care as the cars will make hazardous manoeuvres to stop you overtaking — you have been warned!

There are two levels of skill, and it might be an idea if you choose the easy option until you've got the hang of the controls. Obviously, the game ends when the 'Miles' indicator reaches zero and someone has won the race. Of course, it could end a lot quicker (know what I mean?).

If you find it all a little daunting to begin with, try altering the value of M in line 400 to 300 for an easy life . . .



On-screen, your dashboard indicates how many miles you have left to race, your position, your car's speed and how fast the car behind is approaching. Care should be your watchword as you hurtle along the open road, for when you start to overtake the leaders you'll find they're not so friendly.

```
   9 REM
Print Instructions & Obtain Skill level
  10 GO SUB 7000: REM Set Up UDG's
  20 BORDER 0: PAPER 0: INK 7: CLS : REM
 Initial screen attributes
  25 GO SUB 7100: REM Draw title screen
  30 PRINT AT 9,2;" Your engine stalls i
n the     middle of the Road Race while
 your in tenth postion,with only 300 mil
es to the finish! Regain the lead using:
"
  40 PRINT AT 16,0;" 'y' for speed    'g'
```



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– What Micro?, Dec 83



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Please describe your Computer

```
to brake";AT 18,0;" 'z' for left  &  'x
 for right"
 50 PRINT AT 21,0; INK i;" Skill Level:
 1=(AM)  2=(PRO) ?"
 55 PRINT £1;AT 1,5; INK i;" Written by
D.Sheehan."
 60 IF INKEY$="1" THEN  LET sk=1: GO TO
100
 70 IF INKEY$="2" THEN  LET sk=2: GO TO
100
 80 GO TO 60
```

Lines 9-80 Print instructions and obtain skill level.

```
 99 REM Set up screen and variables for
 start of game
 100 BORDER 6: PAPER 4: INK 0: CLS : LET
 c=5: LET d=2: LET s=0: LET a=11: LET b=
6: LET pos=10
 200 FOR n=0 TO 21: PRINT AT n,0;"     k█
███████k       ": NEXT n: FOR n=2 TO 19
: PRINT AT n,19; INK 5;"████████████": N
EXT n
 250 INK 0: PRINT AT 3,19; PAPER 7;" ROA
D RACER ": DRAW 255,0: DRAW 0,175: DRAW
-255,0: DRAW 0,-175
 260 PLOT 151,15: DRAW 98,0: DRAW 0,145:
 DRAW -98,0: DRAW 0,-145
 270 GO SUB 2000: REM set up computers c
ar variables: REM
 300 INK 7: PAPER 0: PRINT AT 6,20;"MILE
S:    ";AT 9,20;"POS:        ";AT 12,20;"SP
EED:    ";AT 15,20;"APP/S:      "
 310 RESTORE 7080: FOR n=0 TO 9: READ q:
 FOR w=0 TO 8: BEEP .008,q: NEXT w: NEXT
 n: REM engine noise
```

Lines 99-310 Print the game display, assign the variables, draw a large square around the screen and a smaller one around the 'dashboard'. The BEEPs simulate the engine noise. The 'k' characters in line 200 are, in fact, user-defined graphics characters. (UDGs are obtained by pressing Caps Shift/9, and then pressing the character you want — in this case, the K key.)

```
 399 REM main program loop
 400 FOR m=300 TO 0 STEP -1
 500 PRINT AT a,b; INK 7;"  ";AT a+1,b;"
  "
 550 LET b=b+(INKEY$="x" AND b<11)-(INKE
Y$="z" AND b>5)
 580 PRINT AT a,b; INK 7;"ab";AT a+1,b;"
cd"
 590 GO SUB 3000: REM move and print com
puters car
 599 REM check for crash
 600 IF ATTR (a,b)<>7 THEN  GO TO 4000
 610 IF ATTR (a,b+1)<>7 THEN  GO TO 4000
 620 IF ATTR (a+1,b)<>7 THEN  GO TO 4000
 630 IF ATTR (a+1,b+1)<>7 THEN  GO TO 40
00
 640 PRINT AT 6,26;m;" ";AT 9,26;pos;" "
;AT 12,26;s;" ";AT 15,26;app;" "
 660 LET s=s+(INKEY$="y" AND s<=98)-(INK
EY$="g" AND s>=1)
 670 GO SUB 1100: REM print and move tre
e
 680 NEXT m
```

Lines 399-680 Main program loop. The FOR/NEXT loop 'm' controls how long the race will continue (here it is set to 300, and reduced by one every time the loop goes round). Lines 600-630 check to see if the car has crashed.

```
 999 REM end of game
1000 PRINT AT 6,26; FLASH 1;"000": FOR n
=0 TO 50: BEEP .005,30: BEEP .01,0: NEXT
n: IF pos=1 THEN  GO TO 1050
1020 PRINT AT 1,0;"The leading car has w
on the race": BEEP .5,-10: BEEP .7,-20:
IF pos=2 THEN  PRINT AT 9,5; FLASH 1; IN
K 3;"▚▚▚▚▚▚▚▚";AT 10,5;"▚▚▚▚▚▚▚▚"
1030 GO TO 1080
1050 PRINT AT a+2,5; FLASH 1; INK 3;"▚▚▚
▚▚▚▚▚";AT a+3,5;"▚▚▚▚▚▚▚▚": PAUSE 50
1060 PRINT AT a,b;"▟▙";AT a+1,b;"▜▛";AT
x,y; INK cc;"▟▙";AT x+1,y;"▜▛"
1070 PRINT AT 1,0; FLASH 1; PAPER 2;"
     1ST PLACE !               ": FOR n=0
TO 3: BEEP .5,15: BEEP .2,5: NEXT n
1080 PRINT AT 21,3;"Press any key to pla
y again": IF INKEY$="" THEN  GO TO 1080
1090 GO TO 15
```

Lines 999-1090 Evaluate your position at the end of the game, print the grid and, if requested, re-start the game. Again, user-defined graphics are employed in line 1060.

```
1099 REM print and move tree
1100 PRINT AT c,d; PAPER 4;" ";AT c+1,d;
" ": LET c=c+(s/30)
1130 IF c>=18 THEN  LET c=1: LET r=RND:
LET d=INT (RND*3)+1: IF r>.5 THEN  LET d
=INT (RND*3)+14
1140 PRINT AT c,d; INK 1; PAPER 4;"i";AT
 c+1,d;"j": RETURN
```

Lines 1099-1140 Print the tree character on the side of the road, and move it according to the speed of your car.

```
1999 REM set up computers car
2000 LET app=INT s+INT (RND*sk)-5: LET a
pp=app+INT (RND*20)-INT (RND*20): IF app
<=20 THEN  LET app=20
2010 LET ac=0+(1 AND RND<(sk/10)+.1)-(1
AND RND>.7)
2020 LET cc=INT (RND*5)+2
2100 LET y=INT (RND*6)+6: LET x=2: IF ap
p>s THEN  LET x=18
2110 IF pos=1 THEN  LET x=18
2120 LET pos1=pos: LET pos2=0+(pos-1 AND
 x=2)+(pos+1 AND x=18)
2130 LET x1=x: RETURN
```

Lines 1999-2130 Update the variables of the other cars in the race.

```
2999 REM print and move computers car
3000 PRINT AT x,y;"  ";AT x+1,y;"  ": IF
 s>app THEN  LET x=x+1: IF s-15>app THEN
  LET x=x+1
3010 IF s<app THEN  LET x=x-1: IF s+15<a
pp THEN  LET x=x-1
3020 IF RND>(pos/10) AND y>=6 THEN  LET
y=y-1
3030 IF RND>(pos/10) AND y<=10 THEN  LET
 y=y+1: IF RND>.5 THEN  LET app=app+INT
(RND*2)-1
3100 PRINT AT x,y; INK cc;"ab";AT x+1,y;
"cd": LET app=app+ac: IF app<=20 THEN  L
ET app=20
3120 IF x<3 OR x>18 THEN  PRINT AT x,y;"
  ";AT x+1,y;"  ": GO SUB 2000
3150 IF x1=2 THEN  LET pos=0+(pos2 AND x
>=a)+(pos1 AND x<a)
3160 IF x1=18 THEN  LET pos=0+(pos1 AND
x>a)+(pos2 AND x<=a)
3200 RETURN
```

Lines 2999-3200 Print the computer's car according to the relation between its speed and the speed of your car. The position of your car is also calculated.

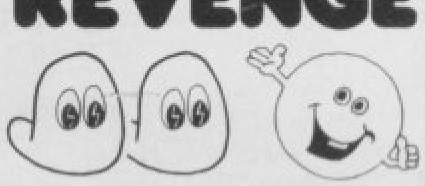
```
3999 REM print crashed car and restart g
ame
```

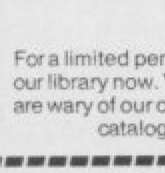


NEW











```
4000 FOR n=0 TO 6: PRINT AT a,b; FLASH 1
: INK n;"ab";AT a+1,b;"cd": BEEP .1,-30:
 NEXT n
4010 FOR n=0 TO 400: NEXT n: GO TO 15
```

Lines 3999-4010 Print crashed car and re-start game. UDGs are used in line 4000.

```
6999 REM Set up UDG's Cars ABCD Tree IJ
Road K
7000 FOR b=1 TO 7: READ a$: FOR n=0 TO 7
: READ a: POKE USR a$+n,a: NEXT n: NEXT
b: RETURN
7010 DATA "a",3,15,3,247,255,255,255,247
7020 DATA "b",192,240,192,239,255,255,25
5,239
7030 DATA "c",30,252,255,255,251,247,247
,15
7040 DATA "d",120,63,255,255,223,239,239
,240
7050 DATA "k",0,60,0,60,0,60,0,60
7060 DATA "i",16,16,24,56,84,124,186,214
7070 DATA "j",84,186,214,124,56,16,16,56
7080 DATA 0,.2,.5,.8,1.2,2,3,2,1,0,-1: R
EM data for engine sound
```

Lines 6999-7080 Define the UDGs. The characters (such as "a", "b", etc) in the DATA statements can be either normal characters or UDGs.

```
7099 REM print title screen
7100 LET a$="███▖ ▟██▙ ▟███ ▟███ ███▖"
7110 LET b$="█  █ █  █ █    █    █  █"
7120 LET c$="███▘ ████ █    ███  ███▘"
7130 LET d$="█  █ █  █ █    █    █  █"
7140 LET e$="█  █ █  █ ▜███ ▜███ █  █"
7150 PRINT AT 0,8;"  R  O  A  D"
7160 LET i=INT (RND*7)+1: PRINT AT 2,4;
INK i;a$;AT 3,4;b$;AT 4,4;c$;AT 5,4;d$;A
T 6,4;e$
7170 FOR n=156 TO 119 STEP -4: PLOT 0,n:
 DRAW  OVER 1; INK i;255,0: NEXT n
7180 RETURN
```

Lines 7099-7180 Draw the program's title using the block-graphics available on the Spectrum keyboard.

```
7189 REM saves and auto-run program
7190 SAVE "ROAD RACER" LINE 10
```

Lines 7189-7190 Save program (cassette).

```
9997 REM Do not type in lines 9997-9999
9998 ERASE "m";1;"ROAD RACER"
9999 SAVE *"m";1;"ROAD RACER" LINE 10
```

Lines 9997-9999 Save program (Microdrive). Do not type these lines in unless you have a Microdrive.

CLOCK THIS

Have you ever got so engrossed in your programming that the hours just ticked by and you missed that important appointment? Well, type in this program and one worry at least will be over.

The Basic program which performs this amazing feat includes two machine code routines as well as a self-performing checksum, which should ensure that you type the program in correctly. However, just to take all precautions, it would be wise to SAVE the program once typed in, before running it.

This done, now let's try it out. One of two things will happen. At worst, it'll respond with an 'Error in data' message, and list the DATA lines where the error occurs. You should now check these lines, restore the program to good health, SAVE the listing to tape and start over.

Should the program run correctly first time, you will be greeted with an 'OK' message and prompted to input the time (in hours and minutes) that you'd like the alarm to be set off. That done, the computer NEWs itself. Don't panic at this stage — the program has not crashed; it's merely waiting for you to start the countdown.

To initiate the timer, simply type RANDOMIZE USR 65120, to which the response should be 'OK', indicating that all is going according to plan. This instruction executes a small machine code routine to set up the interrupt. When your time is up, the program blanks the screen, turning it a glorious shade of red. Again, nothing to panic about — just press the Enter key and you'll find all the work you've been doing is still in memory waiting to be SAVEd so it can be continued at a later date.

Once the timer has been set, you are free to start your programming — up until whenever the alarm is due to go off. Basic programs will not affect the alarm, and most machine code programs should also work (as long as they don't use interrupts nor occupy addresses 65120 upwards).

Don't worry if at any time during your programming you NEW the computer — you won't clear the *Spectrum Alarm*. However, you will need to reset the interrupt by typing in RANDOMIZE USR 65120 again. The timer will thus begin where it left off. Also, PAUSEs, BEEPs, and all LOADing and SAVEing operations, will cause the alarm to stop. But once finished, the alarm automatically resets itself, so you shouldn't lose too much time.

If you'd like a continuous on-screen printout of the time remaining before the alarm goes off, type in this Basic one-liner:

10 PRINT AT 0,0; PEEK 65532; ":"; PEEK 65533; ":"; PEEK 65534; " ": GO TO 10

```
10 CLS : CLEAR 65119: RESTORE 300
```

Line 10 Lowers RAMTOP and restores the data.

```
15 PRINT TAB 4;"Alarm ClockI.D.Turtl
e"''TAB 5; FLASH 1;"Loading machine code
"
20 LET sum=0: LET i=1
```

Line 15-20 Print the on-screen message, and set the checksum and data counters.

```
30 READ a: IF a>255 THEN  GO TO 50
40 LET sum=sum+a: POKE 65119+i,a: LET
i=i+1: GO TO 30
50 IF sum<>a THEN  GO TO 200
60 LET sum=0: LET i=1
```

Lines 30-60 Read the machine code for the interrupt routine and POKE it into memory. When all the interrupt machine code is installed, check to see whether an error has occured.

```
70 READ a: IF a>255 THEN  GO TO 90
80 LET sum=sum+a: POKE 65128+i,a: LET
i=i+1: GO TO 70
90 IF sum<>a THEN  GO TO 200
```

Lines 70-90 This area of the program carries out the same task as lines 30-60 for the alarm call machine code.

```
100 PRINT "O.K.": PRINT '"How long befo
re alarm?"
110 INPUT "hours";h: POKE 65532,h
120 INPUT "mins";h: POKE 65533,h
130 POKE 65534,0
140 POKE 65535,0
```

ADVERTISERS

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```
150 PRINT '"Don't forget to"'' INVERSE 1;"RANDOMIZE USR 65120"
160 PAUSE 200
170 NEW
200 PRINT "Error in data"
210 LIST 9998: STOP
```

Lines 100-210 Set the alarm time, POKE it into memory and then NEWs the computer.

```
300 DATA 62,9,237,71,237,94,201,911
```

Line 300 The machine code for the interrupt routine.

```
310 DATA 255,243,245,58,255,255,254,0,40,6,61,50,255,255,24,76,62,49,50,255
320 DATA 255,58,254,255,254,0,40,6,61,50,254,255,24,58,62,59,50,254,255,58
330 DATA 253,255,254,0,40,6,61,50,253,255,24,40,62,59,50,253,255,58,252,255
340 DATA 254,0,40,6,61,50,252,255,24,22,62,2,205,155,34,62,23,50,141,92
350 DATA 205,77,13,205,107,13,62,62,237,71,237,86,241,251,201,11903
```

Lines 310-350 The machine code for alarm call routine.

Here is a disassembled listing of the main service routine, which is included in lines 310-350 of the Basic program.

The alarm call routine

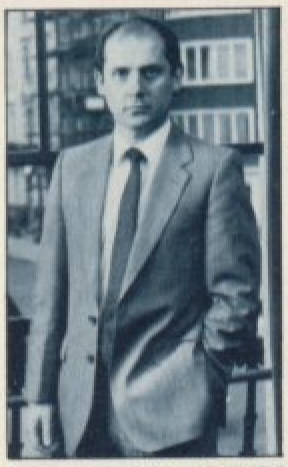
Machine Code		Assembler	Comments
10	CLOCK	RST 56	Performs the keyboard scan which had been diverted.
20		DI	Disable the interrupts, ie. ensure
30		PUSH AF	this routine cannot be interrupted, and save the only register used onto the stack. The addresses used are: 65532 —count of hours remaining. 65533 —count of minutes remaining in the present hour. 65534 —count of seconds remaining in the present minute. 65535 —count of 1/50 of a second remaining in the present minute.
40		LD A,(65535)	Check if the 1/50 of a second counter has gone down to zero.
50		CP 0	If so, jumps to line 100 onwards which causes a decrement
60		JR Z,BMPSEC	in seconds. If not, simply decrements the 1/50 of a second counter and jumps to the returning part of the routine (lines 430-450).
70 80 90		DEC A LD (65535),A JR END	
100 110 120 130 140 150 160 170	BMPSEC	LD A,49 LD (65535),A LD A, (65534) CP 0 JR Z, BMPMIN DEC A LD (65534),A JR END	Decrement the seconds counter and jump to the minutes decrementer (if required).
180 190 200 210 220 230 240 250	BMPMIN	LD A,59 LD (65534),A LD A,(65533) CP 0 JR Z,BMPHOU DEC A LD (65533),A JR END	Decrement the minutes counter and jump to the hours decremeter (if required).
260 270 280 290 300 310 320 330	BMPHOU	LD A,59 LD (65533),A LD A,(65532) CP 0 JR Z,ALARM DEC A LD (65532),A JR END	Decrement the hours counter. If this has already reached zero, it causes a call to the alarm routine.
340 350 360	ALARM	LD A,2 CALL #229B LD A,23	Set the BORDER colour red. Set the attribute colours to PAPER
370 380 390		LD (23693),A CALL #0D4D CALL #0D6B	2: INK 7: FLASH 0: BRIGHT 0 A ROM call to effect a cleared screen.
400 410 420		LD A,62 LD I,A IM 1	Reset the interrupts to the previous mode.
430 440 450	END	POP AF EI RET	Restore the A register, re-enable the interrupts and return.

For those in the know, the data in line 300 of the Basic program generates a short routine to set up the interrupts, its task being to make the computer service the routine at address 65129. Here is the disassembled listing.

The interrupt routine

```
10  LD   A,9
20  LD   I,A
30  IM   2
40  RET
```

CIRCE



***Nigel Searle**, the managing director of Sinclair Research, is usually to be found standing on the edge of Sir Clive's 'white heat' limelight, leaving the public relations work to his dynamic boss. **Your Spectrum's Phil Manchester** tracked him down to a West London hotel and asked what it was like standing in the shadow of genius.*

YOUR SPECTRUM: How would you describe working alongside Sir Clive?

NIGEL SEARLE: It's obviously very stimulating. The biggest difference you'd find compared with working for anyone else is that Clive is not a conservative character in business terms. He doesn't mind taking risks. In many other companies you would be forced to play safe — which is something we at Sinclair Research rarely do. And you get the opportunity to do some pretty exciting things that you just wouldn't get elsewhere.

YS: Can you be more specific?

NS: Well, we were trying to put a deal together with American Express. I was in the US handling the negotiations and they suggested that we should share some of the up-front risk. It required us to make a decision to spend about $1.7 million. I was talking to them on the phone from Boston to New York and felt that it was something I should consult Clive about. So I called him in England and talked to him on the phone — literally for less than a minute. He wanted to know how much and I told him. Then he asked how I felt about the deal and I said it seemed good to me but it wasn't my money. He said it sounded all right to him too and I phoned American Express back within five minutes and said "Yes". I could tell over the phone that they were amazed any organisation could take that sort of decision so quickly.

YS: That's certainly positive enough, but surely working for someone like that must also have its negative side?

NS: Well, he obviously has very strong opinions of his own — but I don't think he undervalues other people's opinions either. You'd hardly be surprised to hear that he is very ambitious and demands a lot of other people. And, like many of us, he gets very impatient when things don't move along as quickly as he'd like them to. But the main thing is if you've got an opposing opinion and back it up with a good argument, then he'll listen.

YS: Your approach to launching products seems a strange mixture of secrecy and hints about what might be coming.

NS: Things happen for different reasons. For instance, the Microdrive was announced the same day as the Spectrum — and we announced it because we thought it was a highly innovative mass storage system and that it would be a prime reason for people to buy the Spectrum rather than any other product. The Spectrum had no disks, so we wanted to make it clear that something was coming that would offer the same sort of thing. So it was done for pre-emptive reasons in April '82. We knew that it was not there and deliverable in April; we never suggested it was.

We did believe in all sincerity that it was going to be available in autumn '82 — but a number of things happened to delay it. One was that we had trouble getting the Spectrum into large volume production, and a lot of engineering effort that would have gone into the Microdrive was diverted to the Spectrum. Also, some of the problems that had to be resolved — the speed and capacity — took longer to solve than we had anticipated.

YS: Is it true that you had to install two extra phones at your head office to handle early complaints about the Microdrive?

NS: No. The only thing we decided to do with some early Microdrives — the first hundred or two hundred we sent out — was to include a special letter to the customers explaining that they were literally getting the first Microdrives. And we gave them, I think, only a single telephone number — but maybe it was two — for contacting the engineers who worked on the Microdrive. We invited customers to use those numbers in the case of any problems or if they felt they needed any advice.

YS: The Spectrum has come in for its share of criticism especially for the design of keyboard. Was this purely an economic decision?

NS: I think the main consideration was cost. When we designed the Spectrum a couple of years ago, the keyboard offered us a major opportunity to save on costs. In fact, it doesn't matter quite so much nowadays because the price differential between what you find on the Spectrum and a more typewriter-like keyboard is not so great. But it's interesting that IBM has used a Spectrum-like keyboard for its PC Junior, just announced, which is going to sell for $669. I think they are going to have a tough time defending the keyboard at that kind of price.

YS: Did you go for a function-based keyboard because it cut down on the typing?

NS: In some ways we did, but it was more because we saw the Spectrum as a ZX81 with colour. We deliberately chose a design which emphasised the programming side of the machine. At the time it seemed that Atari had the games machine side of things sewn up so it was ridiculous to try and compete with them. Of course, things have worked out very differently.

YS: You obviously had to offer a machine with Basic, despite the criticism the language receives. Did it occur to you that you could have improved on it?

NS: In retrospect I think we could have done more to improve it. In fact we have a project going on within the company now to develop a version of Basic which will get rid of most of the disliked features. The problem is that by the time you do that I'm not sure it's Basic anymore. Perhaps we should just design the language people really want — and then say it's Basic so that they will buy it. But I think the new version will be a significant step forward. Basic is not dead — it's just got a lot of things wrong with it which are fixable. *(The new version of Basic Nigel Searle is alluding to is the command language, SuperBasic, which is present on Sinclair Research's QL computer. For more details on this new device, look no further than QL User in this issue. Ed.)*

YS: Can you explain the thinking behind the decision to modify the early Spectrums with the so-called 'cockroach'?

NS: When you get a problem of that type, if you stop and wait for the new component — a new uncommitted logic array (ULA) — then you've got a hold-up of several months. I think people would rather have a product that works with a 'cockroach' in it than have nothing at all.

And again, times have changed. We were the first company to use the ULA on the ZX81 and I think our use of it showed our lack of experience. I don't think we'll make that mistake again. □



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